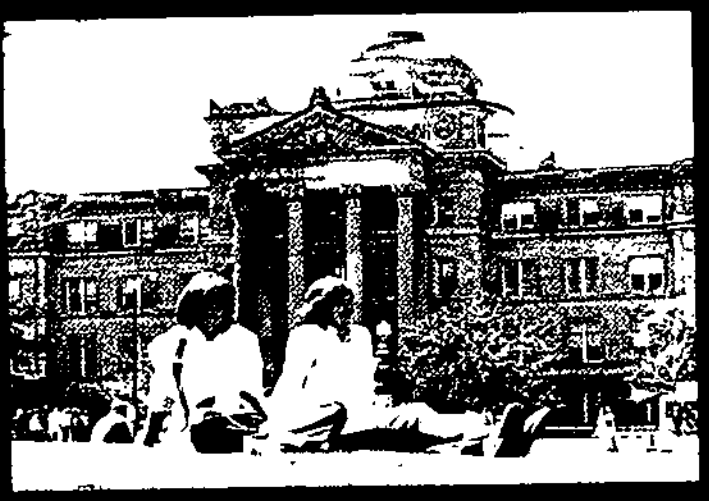
1981

General Catalog 1981'83, Iowa State University Bulletin

Iowa State University



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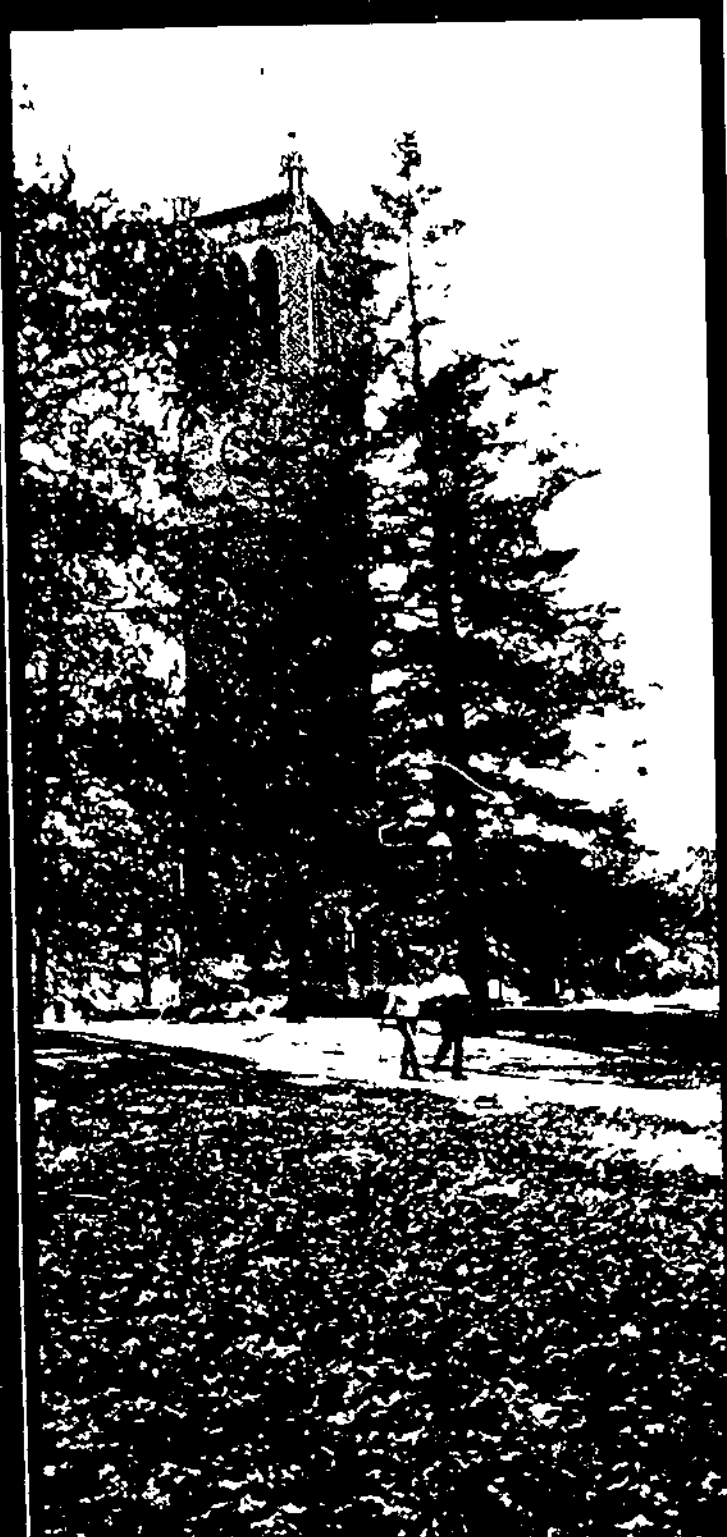

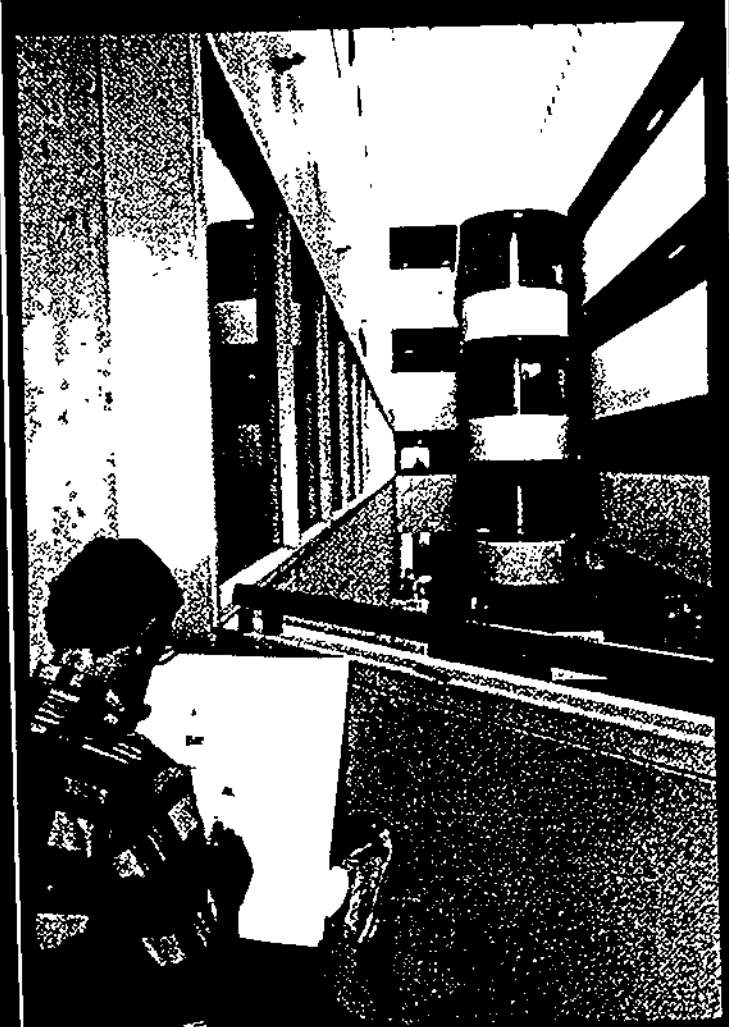

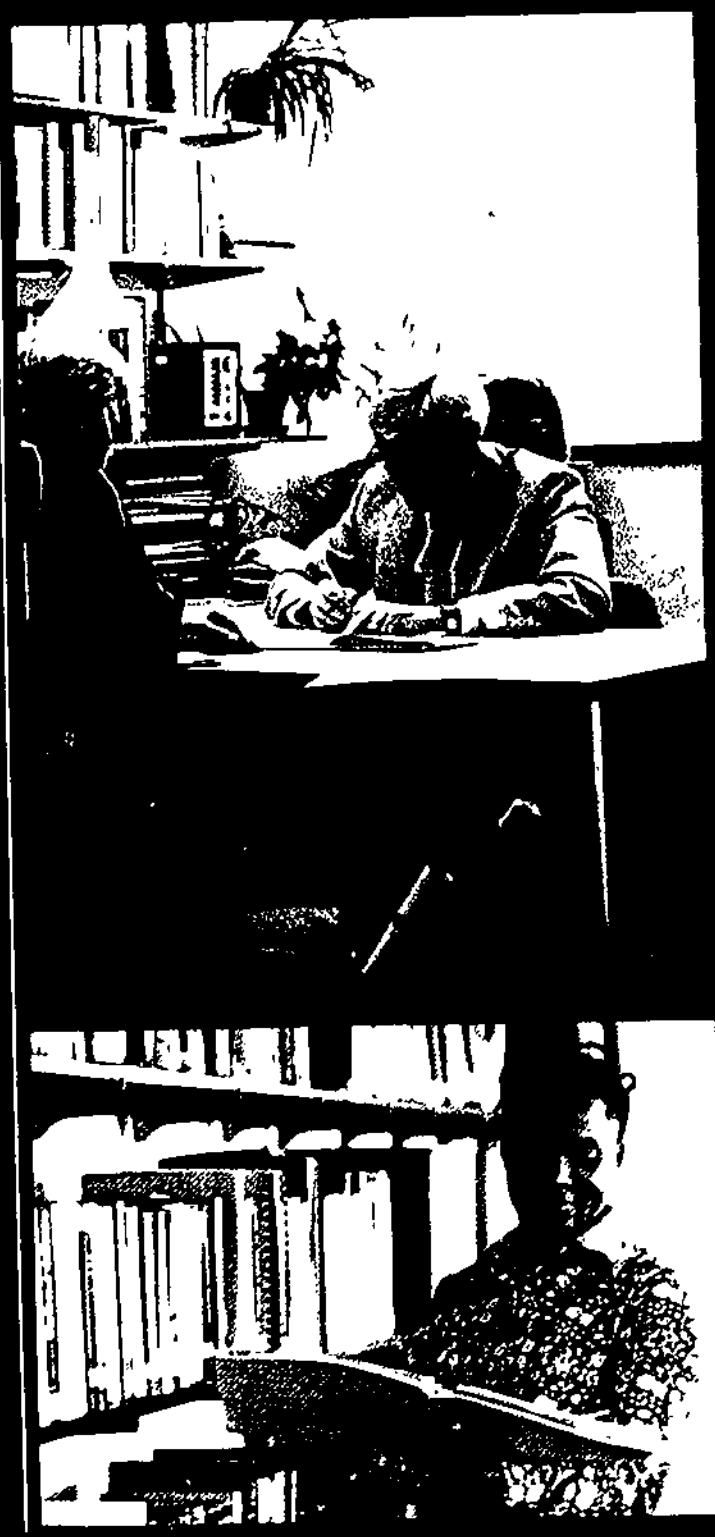

1981'83 Iowa State University Bulletin General Catalog Iowa State University of Science and Technology Ames, Iowa

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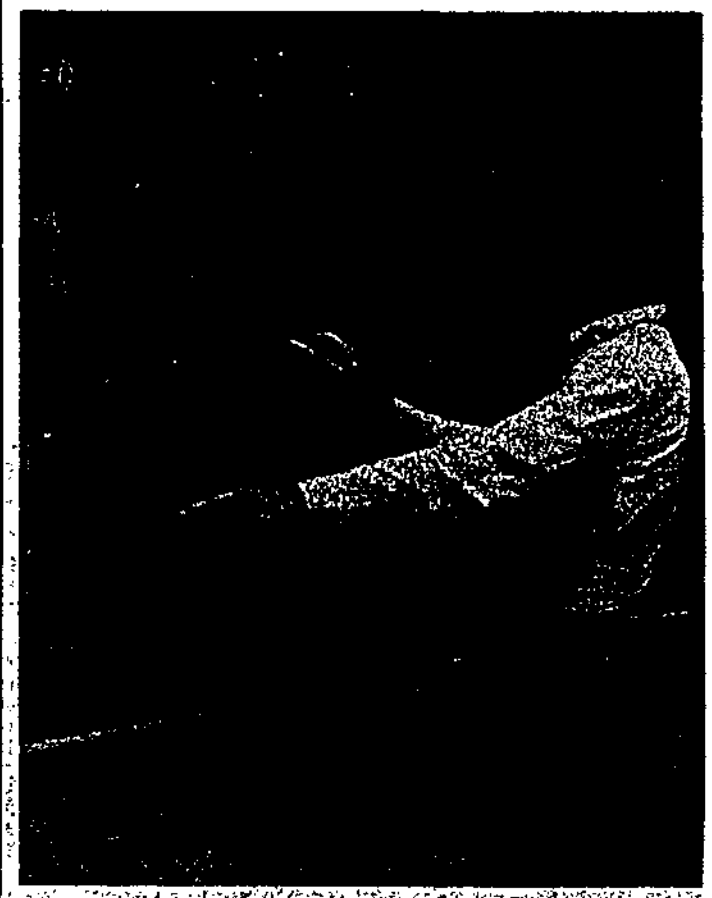

Calendar

	Fall 1981	Spring 1982	Summer 1982	Fall 1982	Spring 1983	Summer 1983
Registration	Aug 24	Jan 11	June 1	Aug 23	Jan 17	May 31
Classes begin, 7 a.m	Aug 26	Jan 13	June 2	Aug 25	Jan 19	June 1
Holiday, office closed	Sept 7	—	—	Sept 6	—	—
Classes recessed, 10 p.m.	Nov 24	March 12	—	Nov 23	March 18	—
Holiday, offices closed	Nov 26-27	—	July 5	Nov 25-26	—	July 4
Classes resume	Nov 30	March 22	—	Nov 29	March 28	—
Holiday, offices closed	—	April 12	—	—	April 4	—
Veisha, classes dismissed noon Thurs	—	Ap 29-May 1	—	—	May 5-7	—
Graduation	Dec. 19	May 15	July 24	Dec 18	May 21	July 23
Holidays, offices closed	Dec 24-25	—	—	Dec 23-24	—	—
	Jan 1	May 31	—	Dec 31	May 30	—

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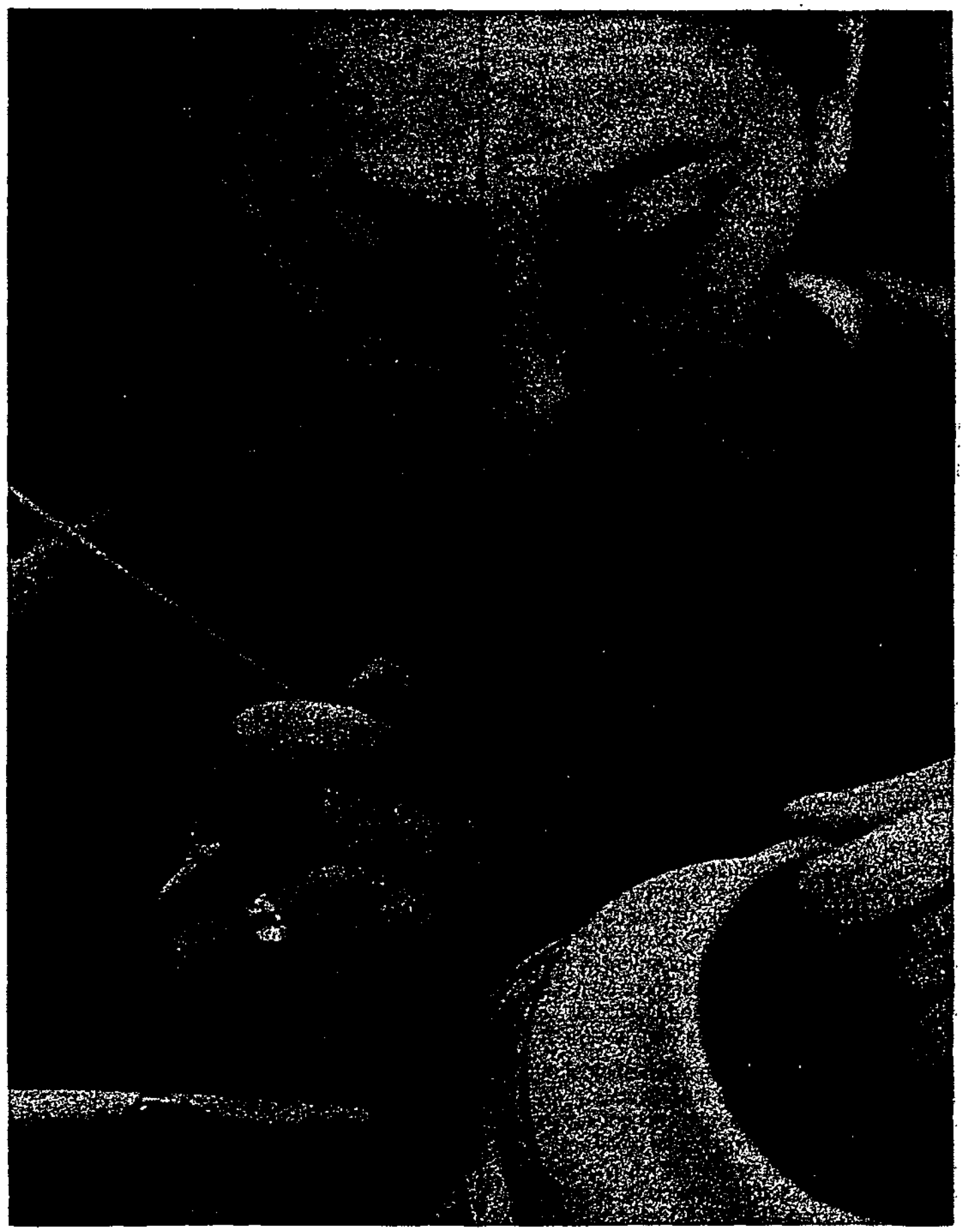


The University

Iowa State University was one of the earliest institutions established in the movement to create an educational system uniquely suited to American democratic philosophy

It was chartered by the Iowa General Assembly in 1858 Four years later the national "people's college" movement was underwritten by the Morrill Land-Grant Act The act made federal lands available for sale to endow colleges whose aim was to promote "liberal and practical education in the several pursuits and professions of life "

Originally these colleges were primarily concerned with subjects relating to agricultural and industrial pursuits Thus this institution was chartered as the "Iowa Agricultural College," and in 1896 was given the more inclusive name, "Iowa State College of Agriculture and Mechanic Arts." In those beginning years it established a national — and in many cases international — reputation in the areas of agriculture, veterinary medicine, home economics, and engineering

Adapting land-grant philosophy to the changing needs of the twentieth century, Iowa State has maintained its preeminence in these areas, but has broadened and strengthened its work in other areas to the point that its largest enrollment now is in the sciences and humanities

Increasing numbers of students find in the broad-based curriculum of Iowa State opportunities to specialize in excellent programs of science and technology, and to acquire a broad general background of education in the liberal arts tradition.

This Iowa State University Bulletin is a general catalog of information regarding fees, curricula, and related policies and procedures. Every effort has been made to make the bulletin accurate as of the date of publication; however, all policies, procedures, fees, and charges are subject to change at any time by appropriate action of the faculty, the university administration, or the State Board of Regents.

The Development of the University

Iowa was the first state to accept the terms of the Morrill Land-Grant Act. In March, 1863, the General Assembly awarded Iowa's grant to the recently chartered institution at Ames. The school opened its doors to a preparatory class in the fall of 1868. Instruction at the college level began the following March. A class of 26 was graduated at the first commencement in 1872. In the 1979-80 academic year more than 4,500 baccalaureate, advanced, and Doctor of Veterinary Medicine degrees were awarded.

Iowa State pioneered in the establishment of agricultural curricula, was the first state institution to found a veterinary school, and helped move engineering from a small and narrow profession to its present key position in our industrialized society. The basic sciences were emphasized Coeducational from its beginning, Iowa State took leadership in domestic economy (later to become home economics)

Graduate study was offered almost as soon as classes began, and the first graduate degree was conferred in 1877 Experimentation and research also started early, first in agriculture and shortly thereafter in home economics, engineering, science, and veterinary medicine

Iowa State shared the conviction with other land-grant institutions that all people should have access to the ideas and knowledge of the campus By 1870 it was holding educational institutes in various Iowa towns In 1903 Iowa State set the pattern of county cooperative extension as it is conducted now throughout the United States

Iowa State's program became that of a university with special teaching responsibility in science and technology, an extension education program throughout the state, and extensive research interests to advance the frontiers of learning.

Since 1959 it has been known as Iowa State University of Science and Technology. Its continuing development in recent years has included the establishment of the College of Education, the College of Design, and the School of Business Administration

Accreditation, Sessions, and Enrollment

Iowa State University is accredited by the North Central Association of Colleges and Secondary Schools as well as by appropriate professional organizations, and is a member of the Association of American Universities.

Instruction is offered throughout the year Prior to 1981, the University's academic year was divided into three quarters. Effective as of fall 1981, however, the academic year is divided into two semesters of sixteen weeks each, beginning in late August and ending in mid-May.

In 1980, Iowa State had an enrollment of more than 23,500 and a faculty of nearly 2,000.

Nondiscrimination and Affirmative Action Policy

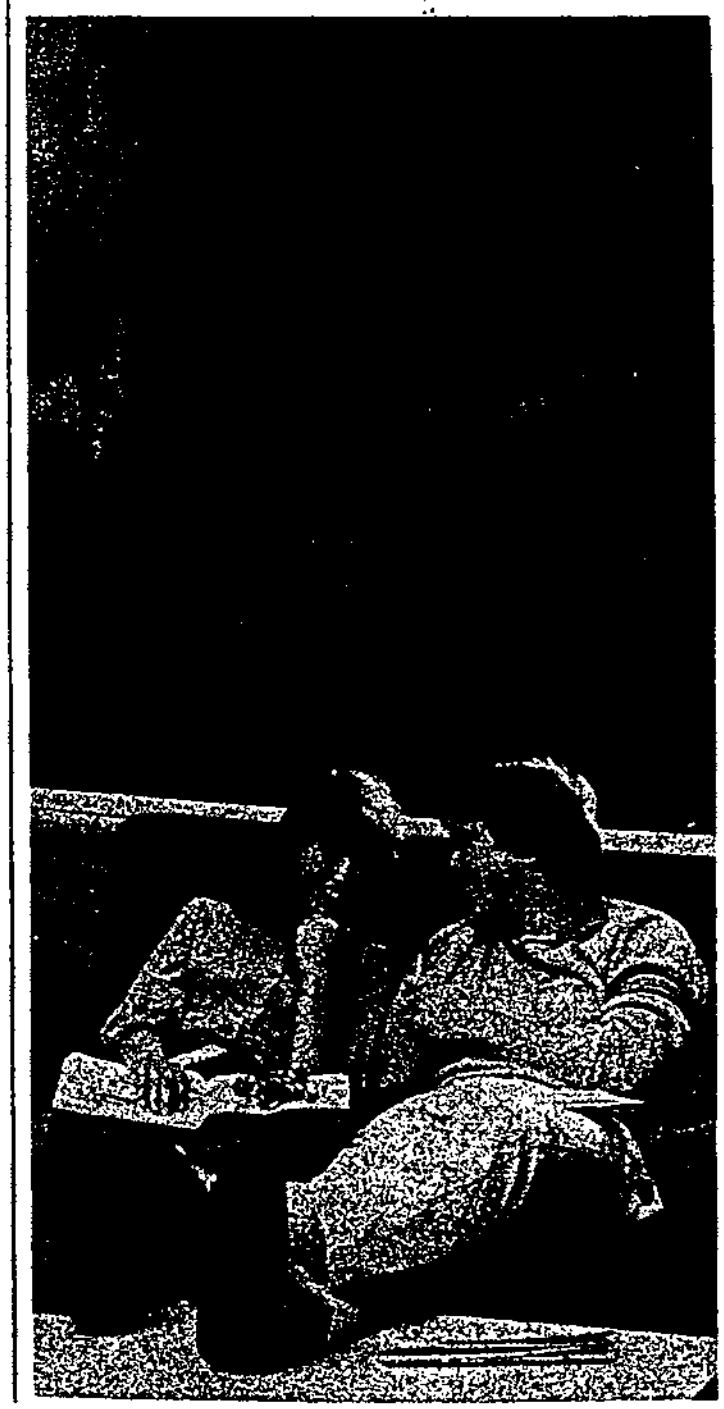
Iowa State University reaffirms its commitment to comply with all applicable federal and state civil rights laws, regulations, and orders.

In keeping with this commitment, the University will ensure that all decisions pertinent to employment, conditions of employment, programs, activities, services and the use of facilities shall be rendered, with few exceptions, without regard to age, color, known handicaps (mental or physical), national origin, race, religion, sex, or status as a disabled veteran or veteran of the Vietnam era. Exceptions to this policy may be made in matters regarding bona fide occupational qualifications, business necessity, and to eliminate problems attendant to underutilization. Race, sex, or other such factors, when used for the purpose of reducing underutilization, must be only one of several factors considered in the selection of otherwise qualified personnel.

Further, the University will regard any act of sexual harassment which contains a threat or insinuation that the lack of sexual submission will adversely affect a person's employment, conditions of employment, academic standing, receipt of services, or other conditions which affect his or her livelihood as a violation of university policies subject to appropriate disciplinary action

This policy applies to all university-sponsored programs and activities as well as those which are planned or conducted under the University's auspices.

Any person who believes that he or she has been the recipient of a discriminatory act prohibited by this policy may file a grievance with the University's Affirmative Action Office at 214 Beardshear. Retaliation against persons filing complaints for the redress of a grievance, or for assisting in an investigation pursuant to the filing of a complaint, shall be prohibited.



Administration of Iowa State University

The laws of the United States and of the State of Iowa provide for resident academic instruction, research, and extension education, and for the management of Iowa State University of Science and Technology. The University and two other state educational institutions of higher learning are governed by the State Board of Regents, composed of nine members nominated by the Governor of Iowa and confirmed by the Senate of Iowa. The immediate regulation and direction of the academic, research, and extension activities of the University are delegated by the Board of Regents to the president and faculty of the University. The Board appoints an executive secretary with over-all responsibility for the administration of the central office of the Board located in Des Moines.

State Board of Regents
Mrs. H. Rand Petersen, President
R. Wayne Richey, Executive Secretary

Terms expire June 30, 1981
Ray V. Bailey . . . . . Clarion
Mrs. H. Rand Petersen . . . . . Harlan
Donald H. Shaw . . . . . Davenport

Terms expire June 30, 1983
. . . . . .
Percy G. Harris, M.D. . . . . Cedar Rapids
Peter J. Wenstrand . . . . . Essex

Terms expire June 30, 1985
S. J. Brownlee . . . . . Emmetsburg
Ann Jorgensen . . . . . Garrison
Arthur Neu . . . . . Carroll

Officers of Administration

William Robert Parks, Ph.D., President of the University

James H. Hilton, D.Sc., President Emeritus

George C. Christensen, D.V.M., Ph.D., Vice President for Academic Affairs

Carl Hamilton, B.S., Vice President for Information and Development

Wayne R. Moore, B.S., Vice President for Business and Finance

Thomas B. Thielen, Ph.D., Vice President for Student Affairs

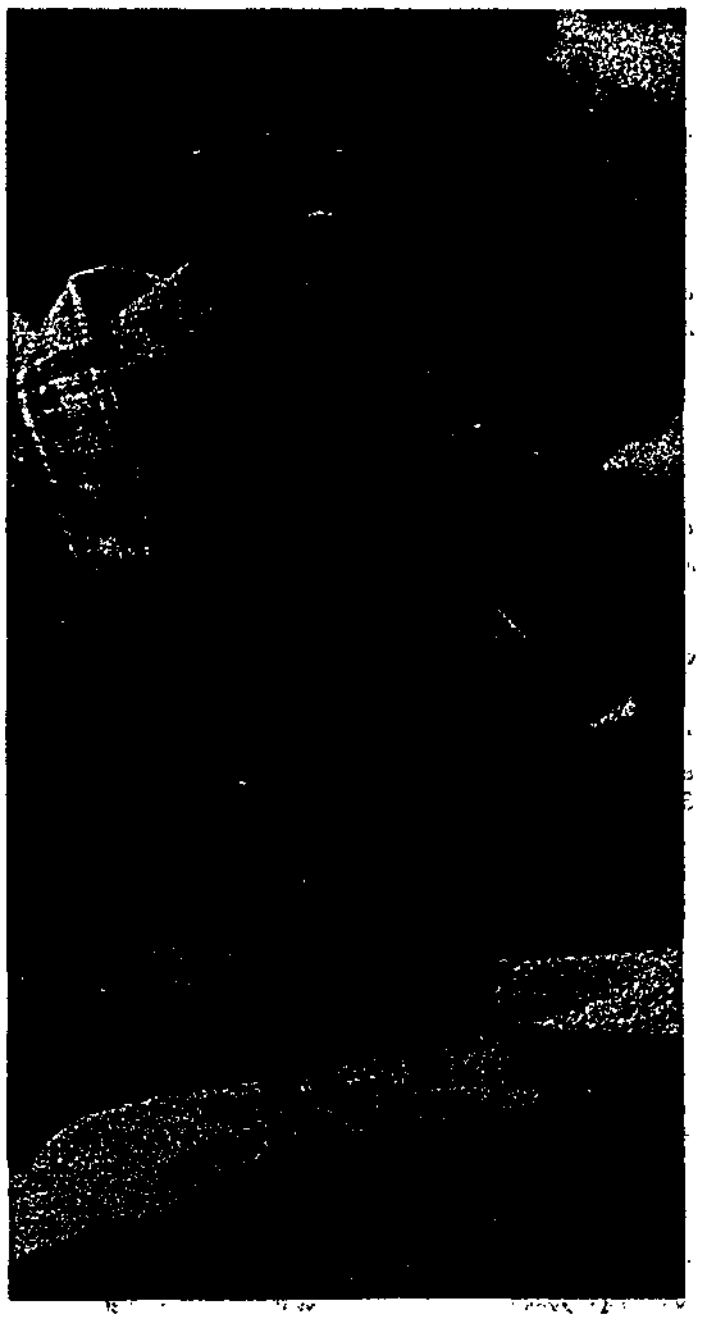
Daniel J. Zaffarano, Ph.D., Vice President for Research; Dean of the Graduate College

Lee R. Kolmer, Ph.D., Dean of the College of Agriculture

Michael P. Brooks, Ph.D., Dean of the College of Design

Virgil S. Lagomarcino, Ph.D , Dean of the College of Education

David R. Boylan, Ph.D., Dean of the College of Engineering



Ruth E. Deacon, Ph.D., Dean of the College of Home Economics

Wallace A. Russell, Ph.D., Dean of the College of Sciences and Humanities

Phillip T. Pearson, D.V.M., Ph.D., Dean of the College of Veterinary Medicine

Robert S. Hansen, Ph.D., Director of the Ames Laboratory, U.S. Department of Energy

Charles E. Donhowe, M.S., Dean of University Extension

Fred C. Schlunz, M.S., Dean of Admissions and Records

Jon C. Dalton, Ed.D., Dean of Student Life

Warren B. Kuhn, M.L.S., Dean of Library Services

Warren R. Madden, M.B.A., Associate Vice President for Business and Finance and Treasurer

Bernard O. Randol, B.B.A., C.P.A., Controller and Secretary

Admissions and Records

Fred C. Schlunz, M S , Dean of Admissions and Records

Arthur M Gowan, Ph D , Emeritus Dean of Admissions and Records

A Weldon Walsh, M.S , Assistant to the Dean

Carolyn J Harryman, B.S , Information Analyst

Records

Registrar: John V. Sjoblom, M.A.

Associate Registrars: W Dean Nelson, M A , Herman L Richtsmeier, M S

Assistant Registrar: Kathleen M Jones, M S

Records Systems Analyst: Joanne A Clark, B S

Admissions

Director: Karsten Smedal, M S

Associate Directors: Maurice L Geist, M A , William R Yungclas, M S

Assistant Directors: Elve Everage, M S , Vern E Hawkins, M S., Patricia J Parker, B A

Admissions Counselors: Lois A Heuer, M.S , Lynn S. Olsen, M.S.

Iowa State University is committed to the concept and practice of affirmative action and does not discriminate on the bases of age, color, handicap (mental or physical), national origin, race, religion, sex, or status as a disabled veteran or veteran of the Vietnam era

Admission

When to Apply

Applicants are encouraged to apply for admission well in advance of their desired entry date. High school seniors or graduates and students transferring from other colleges or universities who seek admission for the fall semester should apply during the fall of the year preceding their entry at Iowa State. Applications for other terms should be submitted 6 to 9 months in advance of the desired entry date.

Completed applications for admission to the professional curriculum in the College of Veterinary Medicine, together with the required supporting transcripts, must be received by an established deadline See *The College of Vetennary Medicine, Applications* for further information

How to Apply

Applications for admission may be obtained by writing to the Office of Admissions, 7 Beardshear Hall, Iowa State University, Ames, Iowa 50011 Applicants should describe their educational backgrounds and indicate the areas in which they plan to study A booklet containing the application form and detailed information concerning admission will then be sent by the Admissions Office

Approximately 2 to 3 weeks after receipt of complete application materials, including transcripts of course work completed as of the time of application, students will be notified concerning the action taken on their applications Admission commitments are issued for a specific semester and may only be used for the term specified.

The Admissions Office, 7 Beardshear Hall, is open Monday through Friday from 8 a m. until 5 p m , and on most Saturday mornings from 9 until 12 Prospective students are encouraged to visit the campus and the Admissions Office to discuss any questions they may have, but personal visits are not required to gain acceptance, in most instances admission can be completed by mail

Persons with questions concerning admission to the University may call the Admissions Office at 515-294-5836, or toll free at 800-262-3810 (from within Iowa) or 800-247-3965 (from all other states except Alaska and Hawaii)

Admission of New Undergraduate Students

Admission of Students Directly from High School

Applicants must submit a formal application for admission, together with a $10 application fee, and have their secondary school provide an official transcript of their academic record, including credits and grades, rank in class, and certification of graduation.

Applicants must also submit scores from the American College Test (ACT) or the Scholastic Aptitude Test (SAT). The Test of English as a Foreign Language (TOEFL) is required of foreign students whose first language is not English.

Applicants may be required to submit additional information or data to support their applications.

a. Graduates of approved Iowa high schools who rank in the upper one-half of their graduating classes will be admitted. Applicants who are not in the upper one-half of their graduating classes may, after a review of their academic and test records, and at the discretion of the admissions officers: (1) be admitted unconditionally, (2) be admitted conditionally, (3) be required to enroll for a tryout period during a preceding summer session, or (4) be denied admission.

b. Nonresidents of Iowa may be held to higher academic standards, but must meet at least the same requirements as resident applicants. The options for conditional admission or summer tryout enrollment may not necessarily be offered to these students.

c. Applicants who are graduates of nonapproved high schools will be considered for admission in a manner similar to applicants from approved high schools, but additional emphasis will be given to scores obtained on standardized examinations.

d Applicants who are not high school graduates, but whose classes have graduated, may be considered for admission They will be required to submit all academic data to the extent that it exists and achieve scores on standardized examinations which will demonstrate that they are adequately prepared for academic study

e Students with superior academic records may be admitted, on an individual basis, for part-time university study while enrolled in high school or during the summers prior to high school graduation

f In rare situations, exceptional students may be admitted as full-time students before completing high school. Early admission is provided to serve persons whose academic achievement and personal and intellectual maturity clearly suggest readiness for collegiate level study

Recommended High School Preparation

Graduation from an approved high school shall ordinarily precede entrance into the University. Students should have completed a program of studies designed to ensure a well-rounded background of knowledge in basic fields; achieved effective study skills and work habits, developed proficiency in reading, writing; and speaking English; and acquired proficiency in basic mathematics

Each college has recommendations regarding high school background. Students who have not had the recommended background may be inadequately prepared for programs in that college.

College of Agriculture. Recommended minimum preparation for the College of Agriculture should include 3 years of English/speech with emphasis in composition and communication skills, mathematics through intermediate algebra, and a strong emphasis in biology and the physical sciences (especially chemistry).

College of Design. High school preparation for students entering the College of Design should include 4 years of English (composition and rhetoric), 1½ years of algebra, and 2 years of science (biology, chemistry, or physics). Social sciences, including a year of world history, and a background in art and drafting, are also extremely helpful and highly recommended Students planning to major in architecture should have an additional background of ½ year of algebra, 1 year of geometry, and ½ year of trigonometry, as well as a year each of physics and chemistry

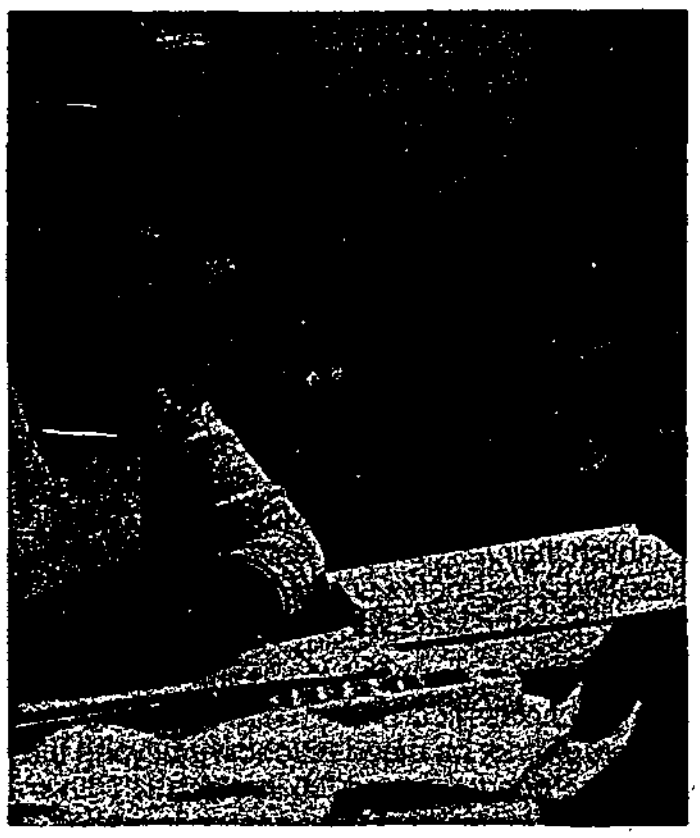
College of Education. The high school program should encompass the various areas of study (English, mathematics, sciences, social studies and humanities) which reflect a broad general background.

College of Engineering. Students who wish to complete an engineering curriculum in 4 years should have high school credit in 3½ years of mathematics, including 2 years of algebra, 1 year of geometry and ½ year of trigonometry Students not having this mathematics background may still enroll in the College of Engineering but should expect to spend longer than 4 years to earn a degree.

In addition to the mathematics background, students interested in engineering will benefit by having had 4 years of English and 1 year each of chemistry and physics.

College of Home Economics. Students will find it beneficial to have at least 1½ years of algebra, 1 year of chemistry, 1 year of biological science, and 4 years of English in their high school program

College of Sciences and Humanities. Academic preparation should include at least 4 years of English composition and rhetoric, 1½ years of algebra, 1 year of geometry, 2 years of science (chemistry, physics, or biology), and 2 years of a foreign language In addition, students planning to study a science or in a science-related discipline should complete ½ year of trigonometry and an additional ½ year of algebra or analytic geometry.



College of Veterinary Medicine. Preveterinary students at Iowa State University enroll in either the College of Agriculture or the College of Sciences and Humanities for their preprofessional study. It is recommended that students contemplating study in Veterinary Medicine complete a full program of college-preparatory subjects in high school, including 4 years of English, at least 3 years of mathematics (including trigonometry), and 1 year each of biology, chemistry, and physics. See also *Veterinary Medicine, Admission Requirements*.

Admission of Students by Transfer from Other Colleges

Applicants must submit a formal application for admission, together with a $10 application fee, and request that each college they have attended send an official transcript of record to the Admissions Office. If less than 1 full year of college-level study will be completed prior to entry at Iowa State, applicants should also request that an official high school transcript be sent to the Admissions Office.

The Test of English as a Foreign Language (TOEFL) is required of foreign students whose first language is not English.

a. Transfer applicants with a minimum of twelve semester hours of graded credit from regionally accredited colleges or universities who have maintained a C average (A.= 4.00) for all college work previously attempted will be admitted. Higher academic standards may be required of students who are not residents of Iowa.

Applicants who have not maintained a C average or who are under academic suspension from the last college attended may, after a review of their academic and test records, and at the discretion of the admissions officers: (1) be admitted unconditionally, (2) be admitted conditionally, (3) be required to enroll for a tryout period during a preceding summer session, or (4) be denied admission.

b. Admission of students with fewer than twelve semester hours of college credit will be based on high school academic and standardized test records in addition to review of the college record.

c Transfer applicants under disciplinary suspension will not be considered for admission until information concerning the reason for the suspension has been received from the college assigning the suspension. Applicants granted admission under these circumstances will be admitted on probation.

d Transfer applicants from colleges and universities not regionally accredited will be considered for admission on an individual basis taking into account all available academic information.

Transfer Credit Practices

Iowa State University endorses the *Joint Statement on Transfer and Award of Academic Credit* approved in 1978 by the American Council on Education (ACE), the American Association of Collegiate Registrars and Admissions Officers (AACRAO), and the Council on Postsecondary Accreditation (COPA). The current issue of *Transfer Credit Practices of Selected Educational Institutions*, published by the American Association of Collegiate Registrars and Admissions Officers (AACRAO), and publications of the Council on Postsecondary Accreditation (COPA) are examples of references used in determining transfer credit.

The acceptance and use of transfer credit is subject to limitations in accordance with the educational policies of Iowa State University.

a. Students from regionally accredited colleges and universities. Credit earned at regionally accredited colleges and universities is acceptable for transfer except that credit in courses determined by Iowa State to be of a remedial, vocational, or technical nature, or credit in courses or programs in which the institution granting the credit is not directly involved, may not be accepted, or may be accepted to a limited extent.

Transfer credit from a two-year college will not reduce the minimum number of credit hours required for a baccalaureate degree if that credit is earned after the total number of credit hours accumulated by the student at all institutions attended exceeds one-half of the number of credit hours required for that degree.

b. Students from colleges and universities which have candidate status. Credit earned at colleges and universities which have become candidates for accreditation by a regional association is acceptable for transfer in a manner similar to that from regionally accredited colleges and universities if the credit is applicable to the bachelor's degree at Iowa State.

Credit earned at the junior and senior classification from an accredited two-year college which has received approval by a regional accrediting association for change to a four-year college may be accepted by Iowa State.

c. Students from colleges and universities not regionally accredited. When students are admitted from colleges and universities not regionally accredited, they may validate portions or all of their transfer credit by satisfactory academic study in residence, or by examination. The amount of transfer credit and the terms of the validation process will be specified at the time of admission.

In determining the acceptability of transfer credit from private colleges in Iowa which do not have regional accreditation, the Regent Committee on Educational Relations, upon request from such institutions, evaluates the nature and standards of the academic program, faculty, student records, library, and laboratories.

In determining the acceptability of transfer credit from colleges in states other than Iowa which are not regionally accredited, acceptance practices indicated in the current issue of *Transfer Credit Practices of Selected Educational Institutions* will be used as a guide. For institutions not listed in the publication, guidance is requested from the designated reporting institution of the appropriate state.

d. Students from foreign colleges and universities. Transfer credit from foreign educational institutions may be granted after a determination of the type of institution involved and after an evaluation of the content, level, and comparability of the study to courses and programs at Iowa State. Credit may be granted in specific courses or assigned to general areas of study. Extensive use is made of professional journals and references which describe the educational systems and programs of individual countries.

Admission of Reentering Students

Reentering students are those who have previously attended Iowa State and are returning after an absence of at least one full term, exclusive of the summer session, in the same status in which they were previously enrolled.

Undergraduate and special students planning to reenter must complete a reentry application and return it to the Admissions Office, 7 Beardshear Hall, Iowa State University, Ames, Iowa 50011. This should be done well in advance of the desired term of reentry since approval is required prior to registration

Graduate students do not need to complete a reentry application, but should notify the Admissions Office well in advance of the opening of the term for which reentry is desired.

Reentering students should, as early as possible, contact their adviser or department to prepare a schedule request for the term in which they are returning. This will assist departmental and classification personnel in preparing the students' class schedules and registration materials.

Classification of Residents and Nonresidents for Admission and Fee Purposes

1. **General.** Students enrolling at one of the three state institutions shall be classified as resident or nonresident for admission, fee and tuition purposes by the registrar The decision shall be based upon information furnished by the student and all other relevant information The registrar is authorized to require such written documents, affidavits, verifications, or other evidence as are deemed necessary to establish the domicile of a student, including proof of emancipation, adoption, award of custody, or appointment of guardian The burden of establishing that a student is exempt from paying the nonresident fee is upon the student.

For purposes of resident and nonresident classifications, the word "parents" as herein used shall include legal guardians or others standing in loco parentis in all cases where lawful custody of any applicant for admission has been awarded to persons other than actual parents

2. **Residence for tuition purposes.** Rules regarding residence for admission, fee and tuition payments are generally divided into two categories — those that apply to students who are under the age of 18 and those who are 18 years of age or older. The requirements in these categories are different. Domicile within the state means adoption of the state as a fixed permanent home and involves personal presence within the state The two categories are discussed in more detail below

3. **Students who are minors.** The residence of a minor shall follow that of the parents at all times, except in extremely rare cases where emancipation can be proved beyond question. The residence of the father during his life, and after his death, the residence of the mother, is the residence of the unemancipated minor; but if the father and the mother have separate places of residence, the minor takes the residence of the parent with whom he or she lives or to whom he or she has been assigned by court order. The parents of a minor applying for admission will be considered residents of Iowa only if they have a domicile within the state at the time of the beginning of the semester, quarter or session in which the minor is first enrolled at Iowa State University or the State University of Iowa, or University of Northern Iowa, and if the parents establish such domicile for purposes other than to qualify their child for resident tuition

A minor admitted before his or her parents have moved to Iowa may be reclassified as a resident at the beginning of the next semester or quarter in which the student is enrolled after his or her parents have a domicile in Iowa. A minor student whose parents move their residence from Iowa to a location outside of Iowa shall be considered to be a non-resident at the beginning of the next semester, quarter or session in which the student is enrolled after the date of the parents' removal from the state

A minor under legal guardianship shall not be granted resident status if the primary purpose of the guardianship is to qualify the minor for resident tuition.

A minor living with and being supported by a relative or a friend who is a resident of Iowa, but not a minor's legal guardian, may be granted resident status if he or she has lived with the relative or friend at least three years prior to high school graduation

4. **Students over 18 years of age and married students under 18 years of age.** A student 18 years of age or older and a married student under 18 years of age shall be classified as a resident if (a) the student's parents were residents of the state at the time such student reached majority or was married and the student is not domiciled in another state, or (b) the student after marriage or reaching majority has established a bona fide residence in the state of Iowa by residing in the state for at least 12 consecutive months immediately preceding the beginning of the semester, quarter or session. Bona fide residence in Iowa means that the student is not in the state primarily to attend a college; that he or she is in state for purposes other than to attempt to qualify for resident status.

Any nonresident student who reaches 18 years of age or is married while under 18 years of age while a student at any school or college does not by virtue of such fact attain residence in this state for admission or tuition payment purposes

5. **General facts.** The resident status for admission, fee and tuition purposes of a married student shall usually be determined under these rules irrespective of the classification of the spouse. Married students under 18 years of age shall be considered to have attained majority as of the date of their marriage.

Persons who are moved into the state as the result of military or civil orders from the government, or the minor children of such persons, are entitled to resident status However, if the arrival of the parents is subsequent to the time of the beginning of the semester, quarter, or session in which the minor child is first enrolled, nonresident tuition will be charged in all cases until the beginning of the next semester, quarter, or session in which the student is enrolled

Dependents of persons whose legal residence is permanently established in Iowa, who have been classified as residents for tuition purposes may continue to be classified as residents so long as such residence is maintained, even though circumstances may require extended absence of said persons from the state. It is required that persons who claim an Iowa residence while living in another state or country will provide proof of the continual Iowa domicile such as evidence that (a) they have not acquired a domicile in another state, (b) they have maintained a continuous voting record in Iowa, and (c) they have filed regular Iowa income tax returns during their absence from the state

Ownership of property in Iowa, or the payment of Iowa taxes, does not in itself establish residence.

A student from another state who has enrolled for a full program or substantially a full program in any type of educational institution will be presumed to be in Iowa primarily for educational purposes, and will be considered not to have established residence in Iowa Continued residence in Iowa during vacation periods or occasional periods of interruption to the course of study does not of itself overcome the presumption

All students not classified as resident students shall be classified as nonresidents for admission, fee and tuition purposes.

A student who willfully gives incorrect or misleading information to evade payment of the nonresident fees and tuition shall be subject to serious disciplinary action and must also pay the nonresident fee for each semester, quarter, or session attended.

An alien who has entered the United States on an immigration visa and who has established a bona fide residence in Iowa by living in the state for at least 12 consecutive months immediately preceding the beginning of the semester, quarter or session may be eligible for resident classification providing he or she is in the state for purposes other than to attempt to qualify for resident status as a student.

Men or women in military service (except career service members) who listed Iowa as their residence prior to entering service and who, immediately upon release, return to Iowa to establish their residence or enter college, will be classified as residents unless their parents moved from the state while the individual was still a minor.

Change of classification from nonresident to resident will not be made retroactive beyond the semester, quarter, or session in which application for resident classification is made.

6. Guidelines. The following guidelines are used in determining the residence classification of a student for tuition purposes.

a. An unmarried minor student claiming emancipation may be required to file any or all of the following:

(1) A statement from the student describing employment and expected sources of support as a student.
(2) A statement from the student's employer.
(3) A statement from the student's parents verifying nonsupport and the fact that the student was not listed as a dependent on tax returns for the past year and will not be so listed in future years
(4) Supporting statements from persons who might be familiar with the family situation

A student who is deemed to be emancipated will be expected to meet the same tests as an adult in determining residence classification

b A minor student whose parents move from Iowa after the student is enrolled remains a resident provided the student maintains continuous enrollment until reaching the age of majority. Minor students whose parents move from Iowa during their senior year of high school will be considered residents provided that they have not established residence in another state.

c. An adult student who was a former resident of Iowa may continue to be considered a resident provided absence from the state was for a period of less than 12 months and provided residence is re-established. If the absence from the state is for a period exceeding 12 months, resident status would need to be re-established in the same manner as for an initial move to the state, unless evidence can be presented showing that Iowa residence has been maintained according to the established criteria. However, a long-term former resident who returns after an absence of more than 1 year but less than 2 years is allowed to regain residency after 1 year even though a full-time student.

d The spouse of a person who moved to Iowa for the express purpose of accepting full-time employment is considered a resident effective at the beginning of the next semester or session following their move to the state.

e. An unmarried adult whose parents move to Iowa and who has been a continuous student or a member of the military service since graduating from high school may become a resident at the beginning of the semester provided the student is dependent upon the parents for major financial assistance.

f. An adult who moves to Iowa may be eligible for resident classification at the next registration following 12 consecutive months in the state provided he or she is not enrolled for more than 8 credits (4 credits during the summer session) in any semester or quarter during that 12-month period.

g. A nonresident student who marries an Iowa resident may be eligible for resident classification at the next registration following the first anniversary of the marriage provided the couple maintains their residence in Iowa during that period.

A nonresident student who marries or is married to a nonresident who is not a student may become eligible for resident classification 12 months after the nonstudent spouse would normally become eligible for resident classification, usually after 12 consecutive months as a nonstudent.

h. An Iowa resident who reaches majority while in the military service will retain resident classification until the conclusion of the regular service tour, assuming that he or she returns to Iowa within 1 year following discharge Peace Corps and conscientious objector alternate service are treated similarly.

i. The spouse of a person in military service who establishes and maintains Iowa residence according to these regulations during the tour of duty of the person in military service, may also earn residence for the person in military service provided the person in military service returns to Iowa immediately following his or her tour, and provided that the person in military service has listed Iowa as his or her home of record for at least a 12-month period immediately preceding release from the service

j. A career military service person who entered service from Iowa and who may retire to Iowa to go to college, or the minor children of a career military service person who is still on active duty, may be granted resident classification if he or she has maintained a valid Iowa residence as evidenced by an Iowa address as the official address of record.

k. If a person who is engaged in a religious vocation is a native Iowan, the time of service in the church is considered the same as required military service or Peace Corps enlistment and resident classification is granted if he or she immediately returns to the state following the church assignment. A missionary who entered such service from the state and who is on furlough may be considered a resident if he or she is returning to the mission field. If service has been terminated prior to returning to Iowa, the person would be a nonresident if the return to the state was more than 12 months from the termination of the services.

The minor children of an active missionary who was an Iowa resident prior to assignment to the foreign field will be granted resident classification.

l. The following facts and circumstances, although not necessarily conclusive, have probative value in support of a claim for residence classification:

(1) Reliance upon Iowa sources for financial support.
(2) Domicile in Iowa of family, guardian, or other relatives or persons legally responsible for the student.
(3) Former domicile in the state and maintenance of significant connections therein while absent.
(4) Ownership of a home in Iowa.
(5) Admission to a licensed practicing profession in Iowa.
(6) Acceptance of an offer of permanent employment in Iowa.

Other factors indicating an intent to make Iowa the student's domicile will be considered by the university in classifying a student.

m. The following circumstances, standing alone, do not constitute sufficient evidence of domicile to effect classification of a student as a resident under these rules.

(1) Voting or registration for voting.
(2) Employment in any position normally filled by a student.
(3) The lease of living quarters.
(4) A statement of intention to acquire a domicile in Iowa.
(5) Continuous presence in Iowa during periods when not enrolled as a student.
(6) Automobile registration.
(7) Other public records, e.g., birth and marriage records.

7. Review committee. The decision of the registrar on the residence of a student for admission, fee and tuition purposes may be appealed to a review committee. The finding of the review committee may be appealed to the Board of Regents.

8. Refugee residency policy. A person who has been certified as a refugee by the appropriate agency of the United States and who enrolls as a student at a university governed by the Iowa State Board of Regents may be accorded immediate resident status for tuition purposes where he or she: (1) comes directly to Iowa from a refugee facility or port of debarkation; or (2) has resided in another state for 100 days or less; and (3) provides satisfactory documentation that he or she has an Iowa sponsor.

Any refugee not meeting these standards will be presumed to be a nonresident for tuition purposes and thus subject to the normal durational residency requirement.

Orientation

The undergraduate colleges of the University, in cooperation with each other and the Office of Student Life, have responsibility for the implementation of orientation programs for new students and parents. The University Orientation Committee is responsible for the year-round planning of the programs and is comprised of representatives of Iowa State University's students, faculty, and staff. The Orientation Coordinator, a member of the Office of Student Life staff, works with the planning body in developing and carrying out the orientation program.

Cyclone Aides, Iowa State students who have been selected to help acquaint new students and their parents with the University, are available at all orientation programs. The Aides are a group of men and women with widely varying backgrounds and interests.

Extensive orientation opportunities are provided in the summer and fall programs. Some colleges hold special orientation sessions for transfer students during the spring. Orientation sessions are also held at the beginning of spring semester, and summer session for all new students entering Iowa State at these times.

Summer Orientation

The summer orientation program, 26 one- to two-day sessions scheduled in May and June, is intended to introduce new students and parents to university life and learning. The primary concern of orientation sessions is to make academic success at the University as likely as possible for the student participants. In addition to a program emphasis on the testing and placement of students in appropriate courses for the first semester, an effort is made to provide time for new students and parents to participate in guided tours of the University and formal and informal meetings with faculty, staff, Cyclone Aides, and other new students and parents. The purposes of such meetings are to create a comfortable, informative atmosphere, lessen existing anxieties, assist each person in the development of a clearer understanding of the challenge of the university environment, and make it possible for new students — with support from their parents — to begin to make the academic and social decisions which are faced by all students at the University.

Entering students are encouraged to attend summer orientation in order to accomplish more thoroughly orientation activities that ordinarily mark the beginning of the fall semester for new students In college mailings sent during the spring, new students are asked to select a convenient time from among a number of orientation sessions that are scheduled during May or June Parents are urged to accompany students whenever possible

Housing and meals are provided for new students and parents in campus residence halls for nominal fees, or participants in summer orientation programs may choose to stay at hotels and motels in Ames Cyclone Aides live in the residence halls with the new students and are availeble at all times for informal discussion

Fall Orientation

The fall orientation program is designed to assist new students who did not attend summer orientation in making a personal adjustment to the University and to enable them to become acquainted with the resources for intellectual and personal development at Iowa State

In conjunction with fall onentation, New Student Week activities are scheduled during the week of the opening of fall semester All new students, including transfer students, are invited to participate in New Student Week Activities of the week include a close look at the new student's college, a look at the extracurricular activities at Iowa State, residence orientation, and entertainment

Cyclone Aides are available to help new students with questions and concerns dunng the fall orientation program

Medical Information

New students will be sent a medical history form with their letter of admission The medical form should be completed and returned to the Student Health Service before registration

Registration

Registration and the payment of assessed fees are required of all who attend classes. Registration is not complete until fees are paid, including board and room fees for those living in residence halls.

Students who wish to initiate registration within the period between the 5th and 10th class day must obtain written permission from the instructors under whom they will be taking work and the approval of the dean of the college in which they will be registered. Registration for any semester will be closed after the 10th class day

For summer session the 5th and 10th class days would be replaced by the 3rd and 5th class days

Classification

Students are not admitted to any class nor are they dropped from any class except by permission of their dean Students may not classify at conflicting hours without the approval of the departments concerned Any student may be required to drop work which is not being accomplished in a satisfactory manner

A change from one college to another within the University requires the permission of the dean of the college to which the student wishes to transfer A change from one curriculum to another in the same college requires the approval of the dean of the college as well as the head of the curriculum to which the student wishes to transfer.

Transcript of Record

Students may obtain a transcript of their academic record for a small fee by contacting the Office of the Registrar, 107 Beardshear Hall

Withdrawal

Students who withdraw from the University during any term of their enrollment should report to their dean. Those who withdraw receive refunds according to university policy outlined under *Fees and Expenses*.

Credit by Examination (Test-Out)

Persons with superior high school background or with college-level proficiency in certain areas may obtain academic credit by means of special examination These examinations are administered by the department offering the course, and anyone interested in taking a test-out exam should check with the appropriate department A fee is charged to take each examination Credit is awarded only to students enrolled at Iowa State

Successful completion of an examination for a given course will earn the student credit for that course This credit will be recorded on the student's permanent record and may be applied toward graduation, but no letter grade will be recorded and the performance will not affect the student's quality-point average.

Iowa State will also grant up to 4 semester-hours credit in each of three areas of the College Level Examination Program (CLEP) — Humanities, Natural Sciences, and Social Sciences — if the student's score meets the minimum level established by the University. This credit is not evaluated as equivalent to any particular courses, but it may be used to meet general education requirements in certain colleges Scores on CLEP exams taken elsewhere may be forwarded to Iowa State for evaluation for credit, or arrangements may be made to take the examinations through the ISU Student Counseling Service

Credit established by examination at another accredited college or university may be accepted at Iowa State if it is accompanied by at least 12 hours of credit earned in residence at the institution making the report.

Some professional programs require regular grades in all preprofessional courses Students who anticipate applying to such programs should inquire about the acceptability of credit by examination before attempting to test out of preprofessional courses

Credit for Military Service

1. Credit may be allowed in military science for service in a branch of the armed forces to the extent that such service approximates the courses in military science offered at Iowa State Inquiry should be made to the appropriate military department regarding the procedure for securing credit This will usually be done by a test-out examination and results reported to the Office of the Registrar.

Students with active military service who wish to complete the requirements for a commission while enrolled at Iowa State should contact the appropriate military department

2 Credit will be allowed for college courses completed through the United States Armed Forces Institute (USAFI) by correspondence study and the Defense Activity for Non-Traditional Education Support (DANTES), subject to the usual rules involving credits of this nature.

3 Credit will be awarded for successful completion of technical or specialized schools attended while on active duty with the armed forces to the extent that the material is applicable toward degree requirements at Iowa State Application for such credit is made at the Office of Admissions The Admissions Office is guided by the recommendations in the American Council on Education publication, *A Guide to the Evaluation of Educational Experiences in the Armed Services*

Regents Universities Student Exchange Program

Iowa State students may take courses at either of the other two Regents universities for Iowa State resident credit Regular, degree-bound students in good standing at any of the three Regents universities may attend another Regents university for a maximum of 2 semesters, and the credits earned at the other university will be counted as resident credit at the home institution. Approval for participation and credit in the exchange program must be obtained well in advance of registration since the department head must approve the acceptance of such credits if these are to apply to the major, and to insure complete processing of the application between the cooperating universities within specified dates for enrollment. Detailed information and application forms for the exchange program are available from the Office of the Registrar

Fees and Expenses

(Fees and tuition are subject to change without notice.)

A registration fee is charged all students of the University. A full registration fee covers most laboratory fees, access to student health facilities, use of the Library, membership in the Memorial Union, and a number of student activities. In certain courses involving special expenses, an additional fee may be charged. These fees are indicated in the course description of the specific courses involved.

Students who are not residents of Iowa pay an additional tuition fee each semester. This tuition fee is assessed in accordance with regulations of the State Board of Regents which are found in this catalog under *Admission and Records*.

All fees and expenses listed in this catalog are effective as of fall semester 1981. They are subject to change without notice.

Fee Schedule

	Resident	Nonresident
Per Semester		
Undergraduate		
(12 or more hours)	$ 475	$1175
Graduate		
(9 or more hours)	540	1243
Veterinary Medicine		
(12 or more hours)	1000	2050

Fees for students enrolled for less than a full course load are given below. There is a minimum 2-hour fee for all students. Audits and zero credit courses are assessed on contact hours and there is a maximum charge for zero credit courses of 3 hours. R credits are assessed as one credit only if no other credits are taken. The continuing registration for graduate students is $80. If the total number of credits includes .5 credit, such as 6.5, fees are assessed as the next larger whole number of credits. Therefore 6.5 credit hours would be assessed as 7 credit hours.

Summer session fees are charged per credit hour as indicated in the hourly fee schedule, except that nonresidence students taking 2 hours or less are assessed at the resident rate.

Hourly Fee Schedule

No. of Hours	Undergraduate Res.	Undergraduate Nonres.	Graduate Res.	Graduate Nonres.	Vet. Med. Res.	Vet. Med. Nonres.
1	$ 80	$ 80*	$120	$120*	$168	$168*
2	80	80*	120	120*	168	168*
3	120	120*	180	180*	252	252*
4	160	160*	240	240*	336	336*
5	200	500	300	700	420	860
6	240	600	360	840	504	1032
7	280	700	420	980	588	1204
8	320	800	480	1120	672	1376
9	360	900	540	1243	756	1548
10	400	1000			840	1720
11	440	1100			924	1892
12 or more	475	1175			1000	2050

*Nonresident students taking 4 hours or less fall and spring and 2 hours or less summer are assessed at the resident rate.

Private Music Instruction

University students, per semester	
1 lesson per week, ½ hour	$ 50
1 lesson per week, 1 hour	80
Nonuniversity students, per semester	
1 lesson per week, ½ hour	$ 90
1 lesson per week, 1 hour	160

Special Students and Noncollegiate Students

Special students and noncollegiate students pay the same fees as undergraduates.

Application Fee

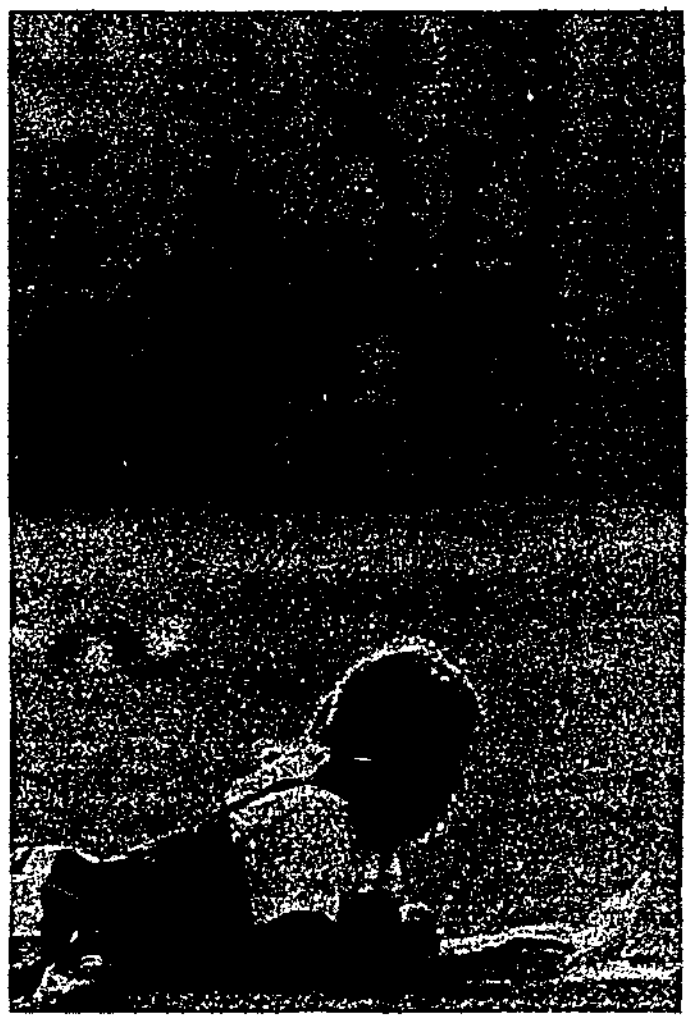
A fee of $10 must accompany the application for admission and is nonrefundable except in the case of residents of Iowa who are denied admission. This fee will not apply to special students or workshop applicants.

Late Registration Fee

A fee of $5 for the first day and $1 per day thereafter is charged to those who do not complete registration during the regular registration period. Maximum charge for late registration is $10.

Reinstatement Fee

Students receiving college approval to be reinstated after having been dropped for nonpayment of fees must pay a $10 reinstatement fee in addition to all other fees due.



Activity Fee

The activity fee for undergraduates and graduate students taking courses on campus is included in the general registration fee. Fees for courses taken off campus do not include the activity fee. Off-campus students may pay $25 per semester which allows them to pay student admission rates to concerts, lectures, debates, and athletic events.

Senior Fee

A $2 fee covers the cost of special senior activities.

Fee Refund for Cancellation of Registration

For those who withdraw during the first week, a 100 percent refund will be made. For those who withdraw after the first week, $80 will be retained and the remainder refunded according to the following schedule:

75 percent if withdrawal is during the second week.
50 percent if withdrawal is during the third week.
25 percent if withdrawal is during the fourth week.
No refund for a withdrawal after the end of the fourth week.

Fee refund for students who drop into light classification or reduce overload:

90 percent if change is made during first week.
75 percent if change is made during second week.
50 percent if change is made during third week.
25 percent if change is made during the fourth week.
No refund after the fourth week.

For the refund policy for off campus courses, contact the Office of Continuing Education.

Change of Classification Fee

Starting the 6th day of classes a $5 fee is charged for course drops, additions, and section changes. Changes approved by the classification office at the same time are charged a single fee.

Workshops on Campus

Graduate and undergraduate students enrolled in 1-credit workshops on campus pay $80 tuition.

Off Campus Fees

For off-campus fees, contact the Office of Continuing Education.

All-University Scholarships

A Family Financial Statement will give a student consideration for the following scholarships:

C. G. Adams Scholarship for a member of Delta Upsilon social fraternity. No application necessary.

Alumni Achievement Fund Scholarship for freshmen and undergraduates.

Athletic Grants-In-Aid for graduating high school seniors. Established by the Big Eight Conference universities. Apply to Department of Athletics.

George Washington Carver Scholarship for students enrolled in journalism and mass communication.

Lowell L. Carver Industrial Education Scholarship for undergraduates majoring in industrial education with at least a 2.00 grade-point average.

George W. Catt Memorial Scholarship for seniors and some juniors. No application necessary.

Class Scholarships for freshmen and undergraduates. Established by the classes of 1911, 1915, and 1917.

Delta Delta Delta Scholarship for an undergreduate woman. Apply to Delta Delta Delta Sorority, 302 Ash Avenue, after arrival at Iowa State University.

Epsilon Chapter of Tau Kappa Epsilon Fraternity Scholarship for a member of that fraternity. No application necessary.

General University Scholarship for freshmen and undergraduates.

Dean Heiser Class of 1955 Scholarship for sophomores and juniors.

Interfraternity Council Scholarship for a freshman. Apply to Interfraternity Council after arrival at Iowa State University.

Iowa Southern Utilities Scholarship for students whose parents are customers of Iowa Southern Utilities. Apply to Financial Aid and Student Employment Office, 12 Beardshear Hall.

Iowa State Club of Chicago Scholarship for a student who will graduate from a high school in the West Suburban and Suburban League of Chicago. Apply to high school principals of respective schools.

Lane-Wells Scholarship for seniors and some juniors. No application necessary.

Laverne Noyes Scholarship for freshmen and undergraduates who are blood descendants of men who served in World War I. Apply first semester to Financial Aid and Student Employment Office, 12 Beardshear Hall.

G. W. Morrison Scholarship for students with a financial need who have shown qualities of leadership, ability, and future credit to ISU.

Schleiter Scholarship program for minority group students

Laurence Bernard Skold Memorial Scholarship for full-time undergraduates

Veishea Leadership Scholarship for entering freshmen living in the United States. Application blanks are sent to high schools in Iowa and to each state's Department of Public Instruction. Applications are due near the end of March. Scholarships are based on scholarship (40%) and leadership (60%). Financial need is not a consideration. Questions should be directed to the Scholarship Co-Chairmen, c/o VEISHEA, INC., Memorial Union, Iowa State University, Ames, Iowa 50011, and high school guidance counselors

Aida Wilson Scholarship for seniors. Must earn major part of expenses and have high scholastic standing

Laura Mae Cameron Scholarship for juniors and seniors

Jessie V. Coles Scholarship for undergraduates

Edward L. Tubbs Family Scholarship for freshmen from 18 specified high schools in eastern Iowa. Apply to the Financial Aid and Student Employment Office, 12 Beardshear Hall

Agricultural Scholarships

Applications for freshman scholarships must be submitted by March 1. Application dates for the sophomore, junior, and senior scholarships are publicized by the College of Agriculture. Students should contact their advisers or the Awards and Scholarship Committee, 118A Curtiss Hall, for further information about these scholarships.

AGRI Industries Scholarship for upperclass students in agricultural business interested in a career related to the marketing of agricultural commodities

Allied Mills 4-H Scholarship for juniors majoring in animal science. 4-H background necessary. Apply to State 4-H Office by Sept. 1

Alpha Gamma Rho 4-H Scholarship for a freshman with 4-H background

Alpha Gamma Rho FFA Scholarship for a freshman with FFA background

Ralph Anderson Scholarship for an undergraduate in agricultural journalism

Floyd Andre Scholarship for residents of Iowa in their freshman year

Julius Black Memorial Scholarship for an undergraduate student in agronomy.

C. E. Bundy Scholarship for a junior enrolled in agricultural education.

Julien L. Boatman Memorial Scholarship for a sophomore, junior, or senior.

Ralph A. Boatman Memorial Scholarship for a sophomore.

C. H. Chase Honorary Scholarship for a sophomore in agricultural business with an interest in the retailing of farm equipment. Sponsored by the Iowa Retail Farm Equipment Association

Chicago and Northwestern Railway 4-H Scholarship for a junior, senior, or graduate student in agricultural business or forestry. 4-H background and essay necessary. Apply to State 4-H Office by Sept. 1

Chicago Farmers' Club Scholarship for a senior

Coles Scholarship for a freshman student selected on the basis of financial need

W. H. Colville Memorial Scholarship for an undergraduate in agronomy. No application necessary

J. Milton Cone Scholarship for a junior in forestry. No application necessary

Rex B. Conn Memorial Scholarship for an undergraduate in agricultural journalism

Continental Grain Scholarship for upperclass students in the College of Agriculture

Cooperative Education Scholarship for freshmen interested in cooperative management who are residents of Allamakee, Black Hawk, Buchanan, Cedar, Clinton, Delaware, Dubuque, Fayette, Henry, Jackson, Johnson, Jones, Keokuk, Linn, Louisa, Muscatine, Scott, Washington, and Winneshiek counties

William A. and Rosalie Rathbone Craft Scholarship in Agriculture for seniors

Crow's Hybrid Corn Agricultural Scholarship for undergraduates who are employees or descendants of employees or dealers of Crow's Corn Company

Cultivate-A-Manager Award for seniors with a demonstrated interest in a career with agricultural cooperatives

J. N. "Ding" Darling Foundation Scholarship for animal ecology or fisheries and wildlife biology undergraduate or graduate students who have an interest in the communications field

DeKalb Agricultural Research, Inc. Scholarship for an agricultural journalism undergraduate

Henry R. Duncan Scholarship for an undergraduate in animal or dairy science

A. T. Erwin Scholarship for a junior or senior in horticulture

Farm Journal-Carroll B. Streeter Memorial Scholarship for a junior or senior in agricultural journalism

Farmland Industries, Inc. Scholarship for juniors and seniors in the College of Agriculture whose parents belong to an agricultural cooperative

Federal Land Bank of Omaha and Federal Land Bank Association in Iowa Scholarship for upperclass students having an interest in a career in agribusiness.

Federated Garden Clubs of Iowa, Inc. Scholarship for undergraduates in horticulture.

Goke Scholarship for agriculture sophomores, in honor of Alvin Goke

Golf Course Superintendents Association of America Scholarship for juniors and seniors enrolled in turf management program

Wayne Gross Memorial Scholarship for a freshman graduating from a high school in Carroll County

Growmark, Inc. Scholarship for junior and senior students having an interest in a career in agri-business

E. S. Haber Award for a freshman in horticulture. Sponsored by the Horticulture Club. No application necessary

E. S. Haber Scholarship for a horticulture or landscape architecture undergraduate majoring in nursery management or planning a career in the landscape nursery business. Sponsored by the Iowa Nurserymen's Association. No application necessary

Cedric Hall for an upperclass student from Woodbury County.

Dennis Healey Memorial Scholarship for an undergraduate in animal ecology or fisheries and wildlife biology

B. Heller & Co. Meat Science for an upperclass student interested in meat science and related industries

Horticulture Club Scholarship for a junior in horticulture

W. J. Hughes Award for a senior in horticulture. No application necessary.

Iowa Crop Improvement Association Scholarship for a junior or senior in agronomy. No application necessary

Iowa Golf Course Superintendent's Scholarship for an undergraduate student interested in a career in turf management

Iowa Hoo Hoo Club Award for undergraduate students in forestry

Iowa Master Farmer's Club — Wallaces Farmer Scholarship for agricultural journalism undergraduates

Iowa Meat Processors Meat Science Scholarship for an upperclass student interested in meat science and related industries

Iowa Pest Control Operators Association Scholarship for an undergraduate student in entomology

Iowa Chapter of the American Society of Farm Managers Scholarship for a junior or senior in the College of Agriculture with an interest in professional farm management

Isabelle M. Isely Scholarship for a junior or senior in horticulture

Izaak Walton League of America and Auxiliary Scholarship for students in fisheries and wildlife biology. Sponsored by several Izaak Walton League chapters in Iowa. No application necessary.

L. G. Keeney Scholarship for a junior or senior in agricultural engineering

James L. Kenney for a freshman who is an Iowa resident planning on a farming career

Kent Feeds Scholarship for a student in agricultural journalism or agricultural business

Don Kirkham Soil Science Award for a graduating senior in agronomy. No application necessary

Knights of Ak-Sar-Ben Scholarship for freshmen from Iowa counties which had exhibitors at the Ak-Sar-Ben livestock show the previous year

Jean L. Laffoon Memorial Award for an undergraduate student in entomology.

Kenneth R. Lynk Memorial Award for an agricultural business student

Edwin T. Meredith Foundation 4-H Scholarship for freshmen in agriculture. 4-H background required. Apply to State 4-H Office by Sept. 1.

Miller Publishing Company Scholarship for a junior or senior in agricultural journalism

Moorman Manufacturing Company Scholarship for freshmen and sophomores

John Morrell & Co. Meat Sciences for an upperclass student interested in meat science and related industries

Charles R. and Ethel Mountain Scholarship for an upperclass student in animal science

William G. Murray Award for an upperclassman with an interest in agricultural finance or cooperatives. No application necessary

National Feed Ingredients Association Scholarships for upperclass and graduate students in agriculture

Rufus Obrecht for an animal science sophomore

Pickett-Volz-Nichols awarded to a sophomore, junior and senior in horticulture.

Poultry Industry Scholarship for students in poultry science. Sponsored by the members of the poultry industry of Iowa.

Production Credit Associations in Iowa Scholarship for freshmen from Iowa farms

Ralston Purina Company Scholarship for a junior or senior in agricultural business, agricultural education, agricultural engineering, agricultural journalism, agricultural mechanization, agronomy, animal science, dairy science, farm operation, or food technology

Rice Estate Advanced Curriculum Scholarship for juniors and seniors.

Rice Estate International Agriculture Scholarship for juniors or seniors majoring in international agriculture

Rural Electric Cooperative Pioneers Scholarship for agricultural journalism undergraduates.

Bruce Russell Scholarship for a junior in agricultural business, agricultural education, agronomy, animal science, dairy science, or farm operation who has an interest in professional farm management.

Olga M. Skott and Orville Ruggeberg Memorial Award for undergraduate students in farm operation.

Soil Conservation Society of America Scholarship for undergraduates interested in conservation careers

Paul P. Stewart Memorial Scholarship for a sophomore, junior, or senior student in dairy science, sponsorcd by dairymen and friends of the late Paul P. Stewart.

Charles Strom Award for a junior student in forestry No application necessary.

Margaret S. Thompson Marketing Scholarship for an undergraduate student planning a career in marketing

Mogens Tolstrup for a sophomore with selection based on scholarship.

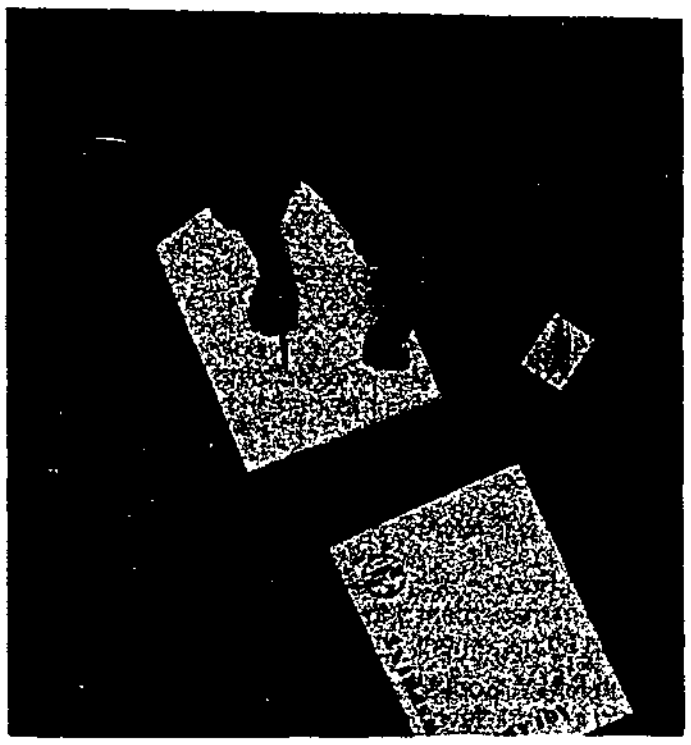
Wheelock Wilson Horticulture Scholarship for a junior or senior in horticulture

H. K. Wilson Advanced Curriculum Scholarship for a sophomore who has earned a 3.00 cumulative average

Wilson Foods Corporation Meat Science for an upperclass student interested in meat science and related industries.

WMT Chuck Worcester Broadcasting Scholarship for a student in agricultural journalism or agriculture interested in farm broadcasting.

Zimmerman Memorial Prize for a junior in horticulture. No application necessary.



Design Scholarships

Students enrolled in the College of Design should contact their departmental office for further information about scholarships and awards.

AIA Scholarship Award for students in architecture.

Janice Peterson Anderson Award for recognition of distinguished artistic performance by students in the Department of Art and Design. Art work retained one year for exhibition.

Thomas A. Barton Scholarship for a junior or senior landscape architecture student.

Charles F. Bowers Award for a senior student in undergraduate architecture program with the best overall grade point record.

Illinois/Iowa Chapter Construction Specifications Institute Award for junior, senior, or graduate students enrolled in architecture who are from the geographical areas of CSI Ill/Iowa Chapter.

Leo Daly Award for a student in architecture on the basis of highest cumulative average upon completion of the fourth year as a tuition grant to be awarded upon acceptance into ISU Graduate College.

Julie Diekmann Scholarship for a senior woman in art and design.

Federated Garden Clubs of Iowa, Inc. Scholarship for an undergraduate student in landscape architecture.

Burdette Higgins Awards Scholarship for a graduating senior in architecture.

Karl Keffer Memorial Scholarship for an architecture student

Kimball Award for architecture students

Ralph Rothacker Memorial Scholarship for a junior or senior landscape architecture student.

Ada Swalwell Scholarship for a senior landscape architecture student.

Clair B. Watson Scholarship for an undergraduate major in the College of Design.

Leonard Wolf Memorial Scholarship for a junior or senior in architecture.

Education Scholarships

W. Price and Lucille Manatt Scholarship for new freshmen enrolling in the College of Education. Apply to the College of Education by May 1 of high school senior year.

Barton Morgan Scholarship for undergraduates enrolled in the College of Education.

Elaine M. Merkley Scholarship for undergreduate junior and senior students enrolled in elementary education.

Education Council Scholarship for entering freshmen and senior students enrolled in the departments of elementary education, industrial education, and physical education and leisure studies.

Ray J. Bryan Scholarship for a senior student in teacher education planning to pursue graduate work in guidance and counseling.

Lowell L. Carver Industrial Education Scholarship for undergraduates in industrial education with a 2.00 grade point average.

Bob Carson Memorial Scholarsip for a black student from Des Moines majoring in industrial education. Available after one semester in industrial education.

Germaine G. Guiot Scholarship for a junior student majoring in physical education. Selection based on demonstrated ability and financial need.

Helen LeBaron Hilton Graduate Student Awards for master's degree students in physical education. Two awards given annually, one for excellence in completed research and one for outstanding teaching.

Winifred Tilden High Scholarship Awards in the Department of Physical Education for freshmen, sophomore, junior, senior, and graduate students. Based on scholastic standing.

Anna R. Toman Dance Award for a full time undergraduate student who has made an outstanding contributon to the dance program.

German G. Guiot Outstanding Senior Award for a senior woman in the Physical Education Curriculum.

Harry Schmidt Outstanding Senior Award for a senior man graduating in the Physical Education Curriculum.

Cherie Goslar Memorial Award for a sophomore woman in the Physical Education Curriculum. Selection based on potential to become an outstanding teacher.

Engineering Scholarships

Applications for all College of Engineering scholarships, awards, and aid funds must be made in triplicate by March 15. All scholarship applications should be addressed to the Scholarships and Awards Committee, College of Engineering, 104 Marston Hall. Application blanks are available in the various departmental offices. (In this section only, a reference to an undergraduate refers to a sophomore, junior, or senior.)

General Motors for juniors or seniors in electrical, mechanical, industrial, metallurgical engineering.

Monsanto for junior Tau Beta Pi members in chemical, electrical, or mechanical engineering.

Statton for undergraduates in mechanical engineering.

Amoco for undergraduates in mechanical engineering.

American Institute of Industrial Engineers for a senior in industrial engineering.

Robert D. Albertson Memorial Award for a freshman in engineering.

Alcoa Engineering Achievement Scholarship for an engineering senior.

Alcoa Engineering Scholarships for undergraduates in industrial engineering, metallurgical engineering, ceramic engineering, electrical engineering and mechanical engineering.

W. B. Boast Scholarship for a junior or senior in electrical engineering.

Boeing Company for undergraduates in aerospace, computer science and civil/structure engineering.

Bourns for a junior or senior in electrical, industrial or mechanical engineering.

Amos E. Buettell for a senior in mechanical or electrical engineering.

Cargill for seniors in agricultural, mechanical and chemical engineering.

Catt & Lane Wells for seniors in engineering

Premo Chiotti Metallurgy Scholarship for all (including graduate) in metallurgical engineering and metallurgical science.

Ceramic Engineering Alumni Fund Scholarship for students in ceramic engineering.

Continental Oil Company for students in chemical engineering.

Electric Cooperative Pioneers Trust for senior in electrical engineering.

Ferro Corporation for junior or senior in ceramic engineering.

Almon H. Fuller for senior in civil engineering.

Murray Gautsch Scholarship in Ceramic Engineering for undergraduates in ceramic engineering.

Jesse Davidson Gaylord Memorial for an undergraduate.

Sidney W. Gaylord Memorial for a junior and senior in civil or construction engineering.

Gibbs-Cook for a junior and senior in civil or construction engineering.

A. P. Green Refractories for an undergraduate in ceramic engineering.

Walter N. Handy Memorial Scholarship for senior in civil engineering.

Henning H. Henningson Memorial for a freshman in electrical engineering.

Honeywell Electrical Engineering Scholarships for undergraduates in electrical engineering.

Cedar Rapids Section of IEEE for junior or senior in electrical engineering.

Ingersoll-Rand for seniors in mechanical engineering.

Donald D. Kaser Memorial for an undergraduate in engineering.

Frank Kerekes Memorial for a junior or senior in civil engineering.

Kimball Memorial Scholarship for a junior or senior in mechanical engineering.

Kodak Employee/Alumni Grant for undergraduates.

Walter T. Lawrence Memorial for a sophomore, junior or senior in electrical engineering.

Maytag Scholarship in Engineering for seniors in mechanical and industrial engineering

Frank McCutcheon for a junior in metallurgical engineering.

James P. McKean Memorial Scholarship for a sophomore in industrial engineering.

Mechanical Contractors of Iowa for undergraduates in construction or civil engineering.

Merril-Schultz & Associate Engineering for junior or senior in civil or construction engineering.

Kenneth G. Meyerhoff Trust for freshman in engineering.

Minnesota Mining & Manufacturing Company for seniors in chemical, mechanical, industrial or electrical engineering.

Monsanto Tau Beta Pi Membership Award for seniors in chemical, mechanical, and electrical engineering.

Nelson Brothers Scholarship for a student in engineering.

Phillips Petroleum for undergraduate in chemical engineering.

Refractories Education for undergraduates in ceramic engineering.

Frank H. Ricker Memorial for junior or senior in engineering.

Harris F. Seidel Scholarship for junior or senior in civil engineering.

Adolph Shane for junior or senior in electrical engineering.

Society of Manufacturing Engineers for undergraduates in mechanical or industrial engineering

Sunstrand Corporation for freshman, sophomore, or junior in mechanical, electrical, aerospace and engineering science & mechanics.

Tektronix for junior and senior in material science and chemical engineering

Russell Thompson Memorial Scholarship for sophomore in agricultural, civil, electrical or mechanical engineering

H. O. Ustrud Memorial for junior or senior in civil engineering

American Society for Metals for undergraduate in metallurgical engineering

Stan Anderson Scholarship Fund for junior or senior in mechanical engineering

Associated General Contractors for undergraduates in civil or construction engineering

Bechtel Scholarship for undergraduates in construction engineering

Henry M. Black Scholarship for junior or senior in mechanical engineering

Black/Veatch Consulting Engineers for undergraduates in civil engineering, mechanical engineering, electrical engineering.

Celanese Scholarships for undergraduates in mechanical and chemical engineering

F. C. Clatterbaugh Company for undergraduates in electrical engineering

Consulting Engineers Council of Iowa Scholarship for junior or senior in mechanical, civil or electrical engineering.

J. B. Davidson Memorial for undergraduates in agricultural engineering.

Dow Chemical for undergreduates in chemical engineering.

FMC Corporation for juniors in mechanical engineering

Green Construction Company for undergraduates in construction engineering.

John Hart Engineering Award for undergraduates in construction engineering.

Hempstead-Walkup Scholarship for junior or senior in industrial engineering.

Hoak Construction Company for freshman in engineering.

Iowa County Engineers Civil Engineering Award for full time undergraduates in civil engineering

Klinger Senior Award for senior in construction engineering.

Master Builders of Iowa for undergraduates in construction engineering

Merit Shop Foundation for undergraduates in construction engineering

Missouri Valley Machinery Company for undergraduates in engineering

Guy W. Morrison Memorial for junior or senior in mechanical, electrical, civil, industrial, or technical journalism

Pioneer Lumber Company for junior or senior in civil engineering

Ben W. Schaefer Memorial Fund for junior or senior in mechanical engineering

Sheffield Brick & Tile Company for undergraduates in engineering

Sheet Metal Contractors of Iowa for undergraduate in construction engineering

Shell for undergraduates in mechanical or chemical engineering

Square D. Engineering Scholarship for freshman in engineering

Union Carbide Corporation for undergraduate in mechanical engineering

H. O. Ustrud Senior Award for senior in civil engineering

Home Economics Scholarships

To apply for scholarships and awards given by the College of Home Economics, a student must (a) complete and submit an application form by April 1 for incoming freshmen and by March 1 for sophomores, juniors, and seniors, and (b) submit a Family Financial Statement (FFS) or Financial Aid Form (FAF) by *February 1*. Application forms are available in the Office of the Dean of the College of Home Economics, 122 MacKay Hall For scholarships given by departments, send your inquiry to the respective department office as indicated below.

Marietta Bamble Anderson Scholarship Fund for a sophomore student in home economics education

Grace M. Augustine Scholarship for a graduate student in institution management. Inquire at Institution Management Department, 11 MacKay Hall

Howard Johnson Company Restaurant Management Award for an undergraduate preparing for a career in restaurant management. Inquire at Department of Institution Management, 11 MacKay Hall

Bishop Buffets, Inc. Scholarship for students in 4-year institution management degree programs. Inquire at Institution Management Department, 11 MacKay Hall.

Lillian Storms Coover Memorial Scholarship for a graduate student in nutrition or dietetics. Inquire at Food and Nutrition Department, 107 MacKay Hall.

Frances H. Crawford Scholarship for a person who intends to work in school food service or is now engaged in school food service work and wishes to prepare further for responsibilities of school food service administration Inquire at Institution Management Department, 11 MacKay Hall

Ruth De Vaul Recognition Award for a graduate student in nutrition Established by the Food and Nutrition Department

Donelson Scholarship for a student in home economics

Elizabeth Dunnihoo Memorial Scholarship for an adult student in food and nutrition

Ercel S. Epright Recognition Award for outstanding upperclass students in food and nutrition No application

Farm Journal Scholarship for a high school student planning to major in home economics journalism. Inquire at Department of Journalism and Mass Communication

Vera Foreman Friley Scholarship for a home economics senior

Carol Sibley Garner Scholarship for a student in institution management. Established by Dr and Mrs James H Garner, Jr Inquire at Department of Institution Management, 11 MacKay Hall

Anna Lee Garrett Gautsch Scholarship for an undergraduate student in home economics who has demonstrated high scholarship and proficiency in the natural and physical sciences. No application

Norma R. Hollen Scholarship for a student in textiles and clothing having junior or senior classification Inquire at Textiles and Clothing Department, 140 LeBaron Hall

ISU Home Economics Alumni Association Scholarship for sophomore, junior, or senior students in home economics Established by the ISU Home Economics Alumni Association

Louise Kelsey Memorial Award for a student in home economics education

Belle Lowe Recognition Award for a senior in food science Established by a bequest in the will of Anha M Olsen No application.

Catherine MacKay Scholarship for freshmen, sophomores, juniors and seniors in home economics

Martha Moffit Scholarship for undergraduate students in food and nutrition in dietetics. Inquire at Food and Nutrition Department, 107 MacKay Hall.

P. Mabel Nelson Scholarship for undergraduate students in food and nutrition who are interested in pursuing graduate study in food science or nutrition.

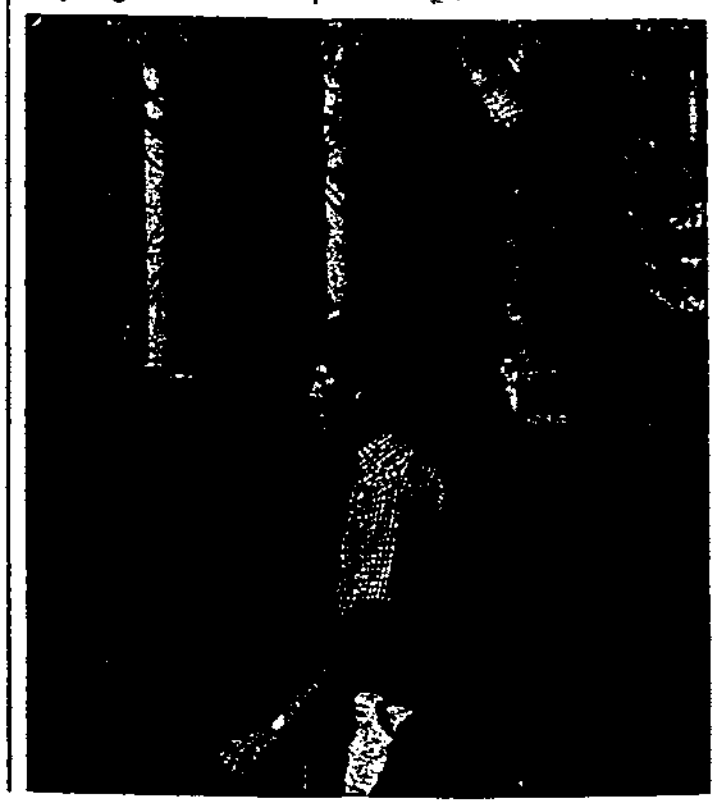
Esther Compton Ogland Memorial Scholarship for an Iowa resident who is a senior in home economics education

Raymond A. Pearson Memorial Scholarship for a sophomore, junior or senior student in home economics.

Florence Pen Scholarship for graduate students in food and nutrition. Inquire at Food and Nutrition Department, 107 MacKay Hall.

Saga Food Service Scholarship for students in institution management. Inquire at Department of Institution Management, 11 MacKay Hall.

Deborah P.N.Y. Sodt Memorial Award for a student majoring in child development.



Stouffer Restaurant Corporation Scholarship for a sophomore, junior, or senior student in institution management.

Veishea Cherry Pie Award for an undergraduate or graduate student in institution management. Established by Institution Management Club and Institution Management Department. Inquire at Institution Management Department, 11 MacKay Hall

Florence Walls Scholarship for sophomores, juniors and seniors in home economics.

Sciences and Humanities Scholarships

Gertrude Herr Adamson Scholarship in mathematics for an undergraduate student who has displayed ingenuity in mathematics. No application necessary

Alcoa Accountancy Award for a junior accounting student in the School of Business Administration No application necessary

Alumni Achievement Fund Scholarship for an outstanding music major performer. Apply to Music Department by January 15 of high school senior year.

Ames International Orchestra Festival Scholarship for an outstanding music major performer. Apply to Music Department by January 15 of high school senior year.

Marjorie Benzler Scholarship for an outstanding music major performer. Apply to Music Department by January 15 of high school senior year.

Cargill Accounting Scholarship for a senior accounting student in the School of Business Administration. No application necessary.

Primo Chiotti Scholarship for an undergraduate in metallurgy Apply to Department of Materials Science and Engineering.

John Deere Accounting Award for a junior accounting student in the School of Business Administration No application necessary.

Ernst and Ernst Accounting Scholarship for a senior accounting student in the School of Business Administration. No application necessary.

George Freeman Memorial Scholarship for a junior, senior, or graduate student in general or rural sociology

Charles A. Goetz Scholarship sponsored by the Dow Chemical Company for a freshman in chemistry Apply to Department of Chemistry at the end of the first semester of high school senior year.

Hayward-Goodspeed Scholarship for a sophomore in the Department of Biochemistry and Biophysics No application necessary.

Pearl Hogrefe Award for undergraduates and graduates who display unusual promise as writers. Applications accepted spring semester. Department of English.

Dio Lewis Holl Award to an outstanding senior who completes work in the current academic year in the curriculum in mathematics.

Alfred P. Kehlenbeck Memorial Scholarship for an outstanding junior or senior in foreign languages and literatures. Apply to Department of Foreign Languages and Literatures.

Alva Lauer Award for the outstanding senior in applied experimental psychology. Department of Psychology. No application necessary.

James and Rachel Lowrie Award for outstanding students in literature. Department of English. No application necessary.

Thomas H. McBride Scholarship in natural sciences to undergraduates for expenses at Iowa Lakeside Laboratory. Apply to Director, Iowa Lakeside Laboratory, Zoology Department, University of Iowa, Iowa City.

Robert McCowen Memorial Scholarship for an undergraduate student who has contributed to musical activities. No application necessary.

McFarland Clinic Partnership Memorial Scholarship for students preparing for study of human medicine. Apply to Department of Zoology by April 1.

I. B. McGladrey Accounting Award for a senior accounting student in the School of Business Administration. No application necessary.

Ilza Niemack Violin Scholarship to an outstanding music major violinist. Apply to Music Department before January 15 of high school senior year.

Physics Department Award: undergraduate scholarship award for freshman, sophomore, junior and senior students; graduate student awards: Richard G. Patrick Award for outstanding teaching; Fox Research Award No application necessary.

Purchasing Agents Scholarship for a junior or senior in the general area of purchasing No application necessary.

Schrampfer Scholarship Fund provides awards in varying amounts to students showing academic achievement and contributions to the School of Business Administration. The fund was established by alumni of the department and named in honor of Emeritus Professor and former department head William H Schrampfer

Laura Vernon Scholarship awarded by Sciences and Humanities Council, School of Business Administration, and participating college departments to students currently enrolled. Apply at beginning of spring semester to participating departments or to School of Business Administration.

Louis Semmons Scholarship for outstanding junior or senior in foreign languages and literatures. Apply to Department of Foreign Languages and Literatures.

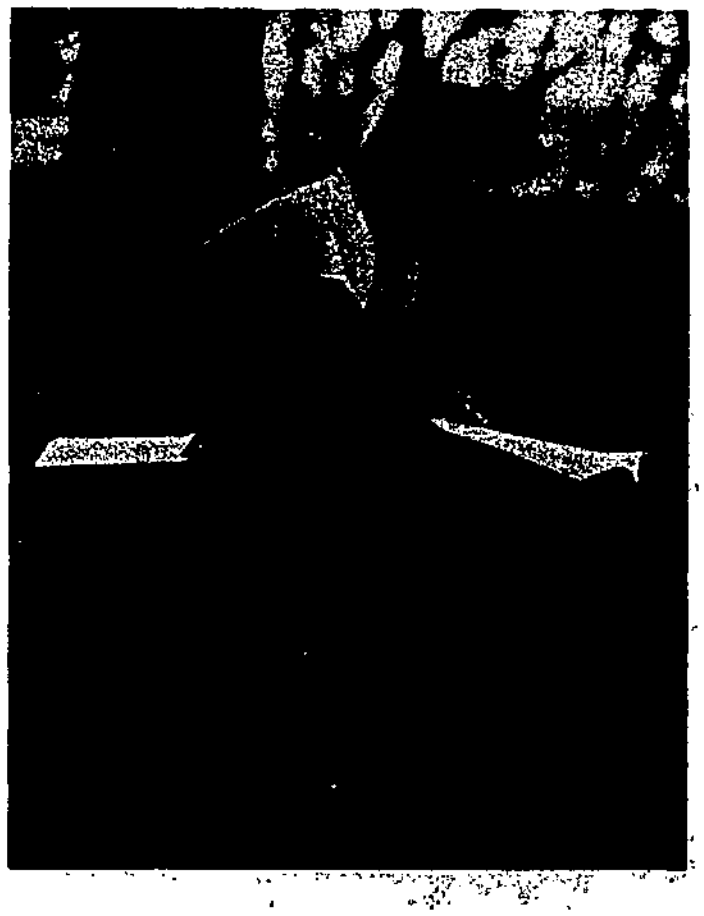
Fredericka V. Shattuck Scholarships for freshmen, sophomores, and juniors who display talent in and dedication to theatre. Apply to Department of Speech.

Shell Company Foundation Scholarship for a senior in the Department of Computer Science. No application necessary.

Rudy Van Drie Memorial Scholarship for e junior in the School of Business Administration who has strong interest in the free community publication business. No application necessary

Von Tungeln Award for undergraduates and graduates in sociology. Apply to the Sociology Department

Will C. Jumper Award to a promising undergraduate or graduate writer of fiction, poetry, or drama. Applications accepfed spring semester. Department of English.



Veterinary Medicine Scholarships

Ak-Sar-Ben Award to one student who has completed the third year of veterinary medicine curriculum.

Allen Products Scholarship for students in veterinary medicine with financial need.

American Animal Hospital Association Award for a senior AAHA student affiliate member for clinical proficiency in small animal medicine and surgery.

American Veterinary Medical Association Women's Auxiliary Award for a senior veterinary student.

Bullis Scholarship in Avian Medicine for a third or fourth year student entering graduate school and pursuing avian medicine.

Diamond Laboratories Scholarship for juniors who have financial need and are in the upper third of their class.

Dubuque County Veterinary Medical Society Award is presented to a third-year student in veterinary medicine interested in practice.

Dubuque Kennel Club Scholarship for a third-year student who has an interest in small animal practice, good scholastic standing, and financial need.

Ralph O. Fuehring Memorial Scholarship for a junior student who has shown an unusual amount of care and consideration for small animals.

G. G. Graham Scholarships for graduating seniors in clinical medicine.

Hawkeye Kennel Club Scholarship for a senior student, resident of Iowa, with an interest in small animal medicine and surgery.

Tom Huerter Memorial Award is presented to a first-year student who is an Iowa resident. Based on need, integrity, and scholarship.

Oris P. Idsvoog Memorial Award to a senior student interested in large animal medicine and surgery. Preference given to seniors from the states of North Dakota and Wisconsin.

Iowa State Chapter of the American Veterinary Medical Association Auxiliary Award for a married sophomore student whose spouse is an auxiliary member.

Iowa Veterinary Medical Association Auxiliary Award for an outstanding senior student in clinical medicine.

Keomah Kennel Club Scholarship for a worthy veterinary medicine student with financial need with preference to residents of Keokuk, Mahaska, and bordering counties of Iowa.

Arthur B. Lederer Memorial Award is offered to a fourth-year student with an obvious desire to excel in the area of pet practice.

Dr. O. J. Mayfield Veterinary Medicine Award for a sophomore student with need.

Merck Veterinary Manual Award given to a junior and a senior.

Nelson Laboratories, Inc. Scholarship for a student completing the second year in veterinary medicine. Selection based on financial need and scholastic achievement.

Pals Veterinary Food Hygiene Award for e junior student who has shown the greatest proficiency and interest in veterinary food hygiene.

Charles Pfizer and Company Award for a junior in veterinary medicine. Applications are submitted to the chairperson of the Honors and Awards Committee.

Riser Small Animal Award for a senior in small animal medicine and surgery.

Southeastern Iowa Kennel Club Scholarship for a junior student from southeastern Iowa with an interest in small animal medicine and surgery.

Paul F. Starch Phi Zeta Award made to a first-year veterinary student showing those qualities of character, interest, and leadership which the Society of Phi Zeta emphasizes.

Charles Steele Memorial Award for a second-year student who has contributed most to the welfare of classmates.

Walnut Grove Products Co. Award for a fourth-year class member who shows the most interest and ability in the area of large animal nutrition.

Frank Walsh Memorial Scholarship for sophomores, juniors, and seniors.

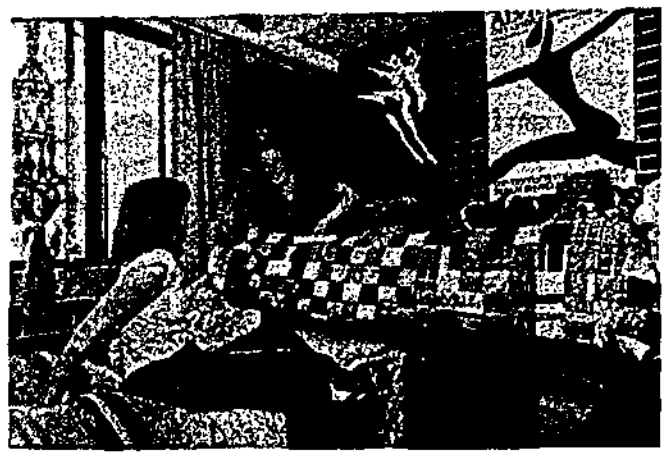
Iowa State University Veterinary Medical Alumni Association Scholarships

Henry Dale Bergman Award for a third-year student in veterinary medicine.

ISU Veterinary Medical Alumni Association Award for the fourth-year veterinary student with the highest scholastic average.

Ival Arthur Merchant Award for a second-year student in veterinary medicine.

Burton C. Thomson Award for a first-year veterinary student.



Student Housing

Director: Charles F Frederiksen, M.S.

Assistant Directors: Carlton T Moen (University Student Apartments), Ph.D., Gary G Schwartz (Union Drive), M.A.; Virginia C Arthur (Towers), M.A , James F. Day (Richardson Court), M.Ed., Thomas E. Walsh (Food Service), M S.

Coordinator, Personnel Services: Robert J Benson, M.S.

Manager, Administrative Services: L R McFarlin, B C S

Manager, Food Stores: Robert Greiner, B S

Manager, Single Housing Maintenance: Donald D Schoof

Coordinators of Residence Life: Ann Coppernoll, M A , Sally Kotval, M A , Glenn Buger, M Ed , William Zeller, M S , Anne Williams, M Ed , Delores Rice, M.A., Patricia Robinson, M.A ; Donald Whalen, M A

The University provides housing facilities for approximately 4,100 single undergraduate women, 4,900 single undergraduate men, 254 single graduate men, 136 graduate women, 1236 family apartments, and apartment space for 720 single students. Chapter houses are maintained near the campus by 31 fraternities and 16 sororities They house approximately 2,400 students Other students live in private rooms and apartments in Ames or nearby communities

Each newly admitted student to the University who requests housing information will receive a housing application form with his/her letter of admission. The student's name will be placed on the waiting list for assignment according to the date the completed application and housing deposit are received in the Department of Residence Administrative Office Admission to the University is necessary before obtaining a housing application.

A deposit is required at the time an application form is completed for accommodations in the residence halls or when an application card is completed for a family apartment or single student apartment operated by the University.

Address correspondence concerning undergraduate and graduate single student housing to the Administrative Office, Department of Residence, 1215 Friley Hall, Iowa State University, Ames, Iowa 50012, or to the Director of University Student Apartments, 100 University Village, Ames, Iowa 50010, for family or single student apartments

Undergraduate Residence Halls

Residence halls at Iowa State have complete facilities for comfortable living. All residence complexes have lounges, recreation rooms, and club facilities. Each house in the hall has a live-in resident assistant and each hall has a live-in hall adviser to help students in their residence hall living experiences.

Most of the rooms in residence halls are planned for double occupancy; however, approximately twenty percent are presently accommodating three persons. They are furnished with single beds, innerspring mattresses, chests of drawers, individual study desks, chairs, and a telephone. Students provide their own bed linens, mattress pads, throw rugs, blankets, pillows, towels, and study lamps (except Larch Hall where study lamps are furnished). Students are responsible for maintaining the cleanliness and order of their own rooms. A linen rental service is available.

Cafeteria-style food service is provided for all residents in the halls. Students living off-campus may purchase a residence hall meal ticket These tickets are available at 1215 Friley Hall A choice of dining hall is made at the time of purchase and is subject to space available

A single student who resides in an undergraduate residence hall must sign a contract for room and board for the academic year or the remainder thereof if contract is signed after fall semester begins All charges are subject to change. The rate for the academic year 1980-81 was $1,467.

Students may purchase their housing contracts at any time during the academic year upon payment of a fee If a student does not plan to live in the residence halls the entire academic year, he or she should check with the housing office before signing a contract.

The residence halls are organized geographically into three autonomous student associations: The Towers Residence Association (TRA), the Richardson Court Association (RCA), and the Union Drive Association (UDA) The students in each of these coeducational associations elect a group of executive officers who are responsible for coordinating university events and activities with the association residence hall program. In addition, each association funds and maintains a social program, an intramural program, a camera club, a ham radio club, and numerous committees that supplement the total social educational development of the individual residents. The three associations also jointly sponsor several projects such as the KPGY FM radio station and Residence Hall Week

Each association is further organized into smaller living groups called houses. These houses of 55 to 75 members are the foundation of Iowa State's residence hall program Members of the houses elect their own officers and the majority of all programs are planned on a house participation basis The individual's educational experience is augmented by active participation in the total house program

Most fraternities ask pledges to live in the chapter houses part of the year Therefore, students who plan to pledge and live in a fraternity should check housing facilities in the fraternity before signing a residence hall contract.

Graduate Residence Hall

Buchanan Hall provides housing in 174 single occupancy rooms and 108 double occupancy rooms for single graduate students and single adult undergraduate students. A suite-type room plan provides a semiprivate bath shared by the occupants of two single rooms or two double rooms. Public areas include a lounge, television room, recreation area, vending room, laundry room, and administration office.

Rooms are furnished with single beds, innerspring mattresses, chests of drawers, individual study desks, chairs, and room telephone. Bed linens are furnished and maid service is provided weekly. Students provide towels and study lamps.

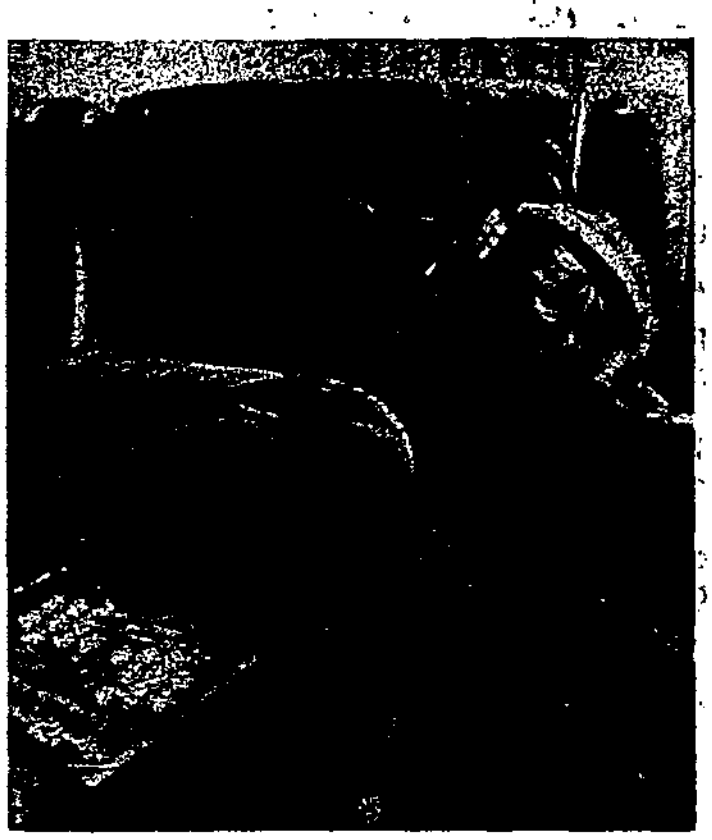
The room rate as of June 1980 was $714 per academic year in a double room, or $939 per academic year in a single room. A meal ticket may be purchased (for $861 per academic year as of June 1980) to eat in a residence hall dining room

Single Student Apartments

There are 105 two-bedroom apartments in Schilletter Village designated for use by single students. The rate for these apartments as of July 1980 was $279 per month per apartment. Each apartment normally houses 4 students.

The apartments are furnished with the same furniture used in the undergraduate residence hall rooms plus range and refrigerator. Water service and trash removal are included in the rent. Students pay their own gas, electricity and telephone.

There are also 150 one bedroom apartments in Pammel Court designated for use by single students. Pammel Court units are furnished with range, refrigerator, drapes, bunk beds and mattresses. Water service and trash removal are included in the $90.00 (July 1980) a month rental rate. Students pay their own gas, electricity and telephone. Each apartment houses two single students.



Family Apartments

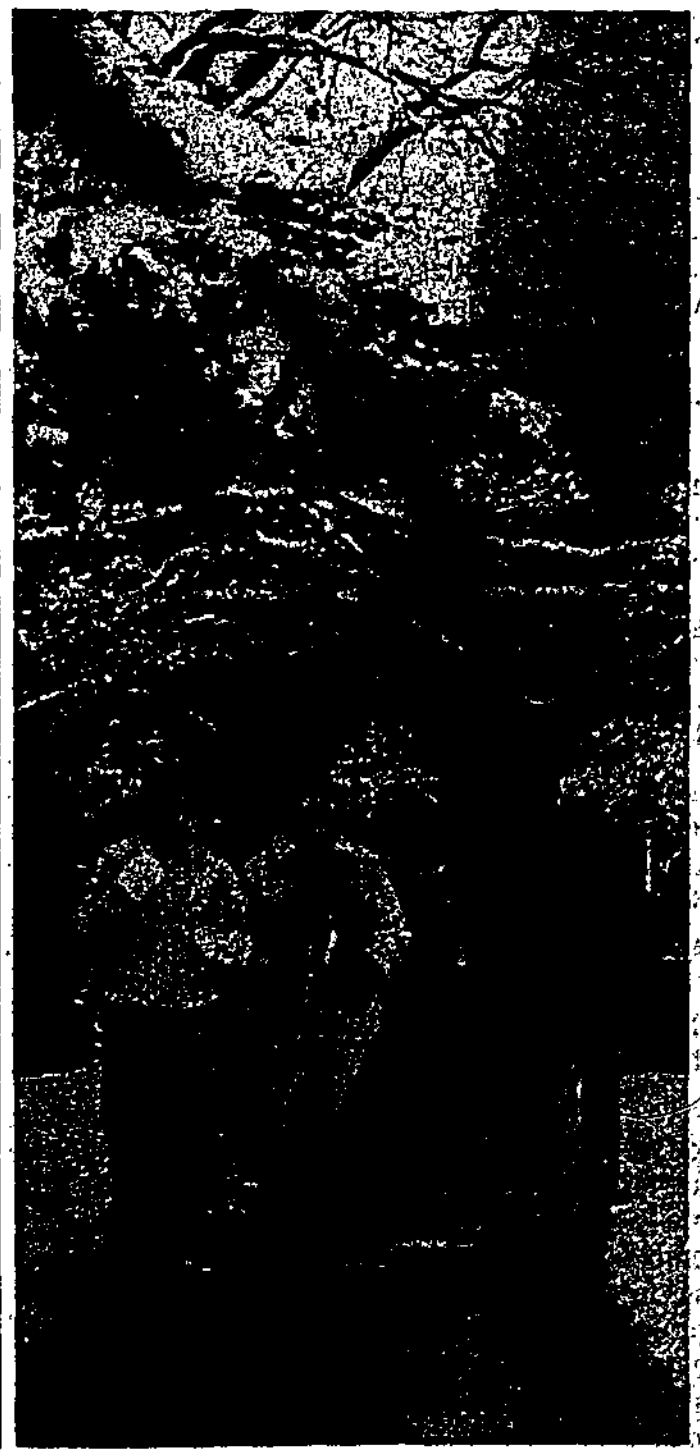
The University provides 155 apartments in Schilletter Village, 500 apartments in University Village, 196 apartments in Hawthorn Court, and 370 apartments in Pammel Court for student families. Rates for these apartments as of July 1, 1980 were $174 per month for Schilletter Village, $159.50 per month for University Village, $148 per month for Hawthorn Court, and $65-$70 per month for Pammel Court. Apartments are unfurnished except for ranges and refrigerators, which are provided in all but Pammel Court. Family apartments in Pammel Court have ranges but not refrigerators. Water service and garbage removal are included in the rental. Residents pay for their own gas, electricity, and telephone.

Approximately 40% of Iowa State's student families live in university apartments. The remainder find accommodations in private homes, apartments, and trailer courts in and near Ames or commute from surrounding communities.

A list of off-campus apartments for student families may be seen at the University Student Apartment Office; however, the majority of the available rentals may be obtained from local newspapers and real estate offices.

Applications for University Student Apartments will be accepted not more than one year in advance of attending the University. Assignments are made by date of application.

Address correspondence concerning student apartments to the Director of University Student Apartments, 100 University Village, Ames, Iowa 50010.



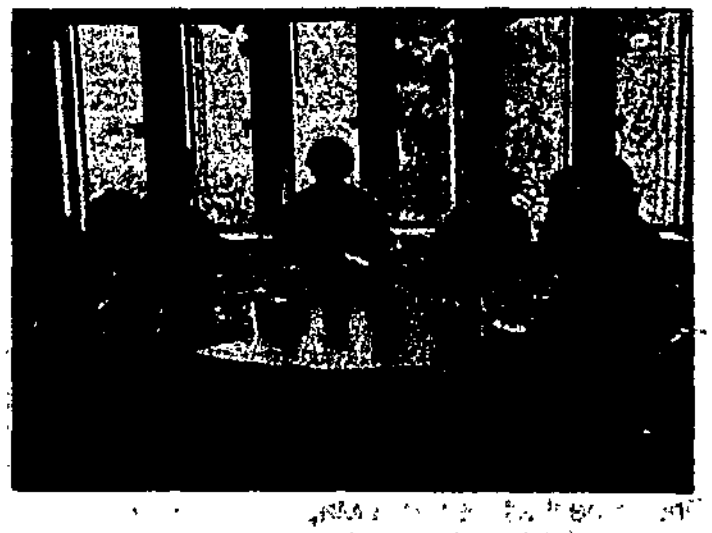
Off-Campus Housing for Single Students

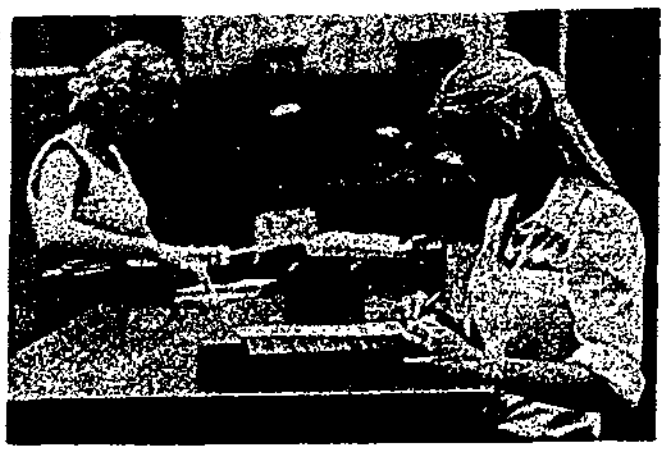
Availability and cost are factors to be considered when living off-campus, as the number of good living quarters is limited. Sleeping rooms in older houses and apartments make up the bulk of off-campus housing.

The Single Off-Campus Housing Office, 1212 Friley Hall, keeps a partial listing of off-campus sleeping rooms and apartments. Other housing may be obtained through real estate agents, local newspapers, or by contacting individual owners.

It is best that the student come to Ames well in advance of the time he or she plans to begin academic work, as many rooms and apartments are rented 3 to 6 months in advance. Because of the variety, it is best to contact the owner directly to make arrangements for housing that will fit requirements of the individual.

The single occupancy room rental rates average $25 per week; the double occupancy room rental room rates average $20 per person per week. The student usually furnishes bed linens, towels, and study lamp. Average rental rate per student sharing an apartment or house would be in the $75 to $85 range per month. Board for students living in off-campus rooms may be obtained in residence hall dining rooms, private restaurants, or the Memorial Union.





Student Services

The University Library

Dean of Library Science: Warren B. Kuhn

The University Library collection affords open-shelf access to more than 1 4 million volumes. Additional holdings of 1 2 million microforms are available in a wide range of subject areas. The Library is particularly strong in the basic and applied fields of the biological and physical sciences and has a long-range program for strengthening collections in the humanities and social sciences. Very complete holdings of periodicals are maintained in botany, chemistry, entomology, mathematics, physiology, and veterinary medicine. The Library receives over 17,500 journals and other serial publications, amounting to world coverage in many scientific fields in major and minor languages

The Library encourages use of its collections, services, and study facilities. Instruction in the use of books and libraries is offered to graduate and undergraduate students

Weekly exhibits of new books in all subjects are held on open-shelf display on the main floor. Current numbers of selected periodicals are displayed in the Periodical and Newspaper Room. On the Library's ground floor are the Reserve Desk, the Microform and Media Center and the Leisure Reading Collection. The Library maintains a Government Publications Department and a Special Collections Department as well as a Map Room with over 70,000 maps and aerial photographs. The University Archives, covering historical documents and photographs important to Iowa State, are located in Special Collections.

There are several subject reading rooms outside the Main Library including the Engineering, Physical Sciences, Economics and Sociology, Design, and Mathematics Reading Rooms. A branch library is maintained in the College of Veterinary Medicine.

Student Counseling Service

Director: Roy E. Warman, Ph.D.

Assistant Directors: Russell J. Canute, Ed.D.; Phyllis G. Miller, Ed.D.

Professional Staff: Melissa C. Andrea, Ph.D.; Tim J. Butler, Ph.D.; Lea M. Hinz, M.S.; Kay Holmberg, M.S.; Equilla Johnson, M.S.; Charles W. Jones, Ph.D.; Daniel C. Robinson, Ph.D.; Katherine S. Schneider, Ph.D.; John S. Westefeld, Ph.D.; Judy M. Winkelpleck, Ph.D.; Dee E. Wright, Ph.D.; Donald G. Zytowski, Ed.D.

Student Counseling Service provides a broad variety of services to assist students in their self-understanding, development, and progression toward goals. Individual counseling may focus on a number of student concerns including curriculum choice, career goals, social and personal adjustment, and mental health matters. Discussions between the student and counselor are confidential. Testing is provided when appropriate, with no charge to regularly enrolled students

Group counseling is provided on topics such as personal growth, assertiveness, career exploration, eating disorders, self-defeating behaviors, and reduction of test anxiety

Other services include Adult Student Information Office, Academic Support Services Office, reading and study skills program, career information resource library, administration of tests for application to graduate and professional schools, and orientation testing.

Student Health Service

Director: Lila Furman, M.D

Physicians: Don Bock, M.D.; Arthur Cloud, M.D.; Leonard Ellertson, M.D.; Manson Fee, M.D.; Rebecca Fritzsche, M.D.; Clem Mattson, M.D.; Pauline Miller, M.D.; Robert Patterson, M D.; Donald Powers, M.D.

The Student Health Service is located in the Student Services Building south of Pearson Hall and next to Alumni Hall. Services provided include outpatient clinic for treatment in the areas of general medicine, gynecology, psychiatry, and sports medicine, emergency room; pharmacy; laboratory; x-ray; and diet service.

Clinic hours are 8-11:50 a.m. and 1-5 p.m. Monday through Friday, and 8 a.m. to 12 noon, Saturday. The clinic operates on a walk-in basis as well as on an appointment system during clinic hours. Emergency service is available 24 hours daily, seven days a week.

All records are confidential. Student records are not available without the student's permission. A copy of the record may be sent to a physician of the student's choice.

A voluntary health fee program enables students to defray their medical expenses by paying a semester fee which entitles them to receive many services free or at a reduced cost. All enrolled undergraduate students and graduate students are eligible to participate in the program. During the summer, students not enrolled in summer sessions but who were students in the spring semester may participate via the voluntary health fee or pay the non-participant student rate. Faculty, employees and visitors (on an emergency basis) will be charged the non-student rate.

Students' spouses can use the Student Health Service, provided both the student and spouse pay the voluntary health fee. The voluntary health fee program is not an insurance plan but a health maintenance plan to complement the student's individual insurance coverage

Placement Offices

Agriculture: Roger Bruene, B S , 118A Curtiss

Design: Janet E Moore, M.S., 134 Design College

Education: Trevor Howe, Ph.D., Quadrangle

Engineering: Herbert A Harmison, Jr , M S , 104 Bldg E

Home Economics: Julie R Muckler, M S , 131 MacKay

Sciences and Humanities: Jack Raymon, Ph D , 104 Bldg E

Veterinary Medicine: Durwood L Baker, D V M , 2510 Veterinary Medicine

The University maintains offices for each of the colleges where employers and prospective employees are brought together Each of these offices assists students and alumni who seek information on career openings in their fields The placement offices are also a resource for students seeking summer employment

Office of Minority Student Affairs

Director: George A. Jackson, Ph.D.

Assistant Director: Juanita Pudwill

Director, Black Cultural Center: Delois Newton

Academic Coordinator: Robert A. Broadus

Program Coordinators: Patricia A. Pinckney, Maria C. Mumby, Teresa Nieves

The Office of Minority Student Affairs is designed to give leadership to the University's mission in the area of equal educational opportunity. The office strives to maximize the educational and personal growth of students by identifying and assisting to develop and promote programs which will enable students and staff to achieve to their fullest potential.

In addition, the Office of Minority Student Affairs works closely with all units in the University to achieve the following objectives:

1. Increase the number of entering and graduating minority students.

2 Review the concept of equal educational opportunity and recommend changes in university policy(ies) that may limit or prevent the achievement of educational and cultural goals of minorities.

3 Ensure access and persistence of minority students in every discipline and area of study offered by the University

4. Maintain liaison with all departments and organizations interested in the growth and development of students

University Recreation Services

Coordinator: Larry Cooney, Ed.D.

Program Coordinator: John Meyer, M S , Steve VanDerKamp, M S , Scott White, M S , Al Murdoch, M.S ; Garry Greenlee, M.S.

Program Adviser: Linda Marticke, M.S

The office of University Recreation Services is dedicated to the provision of quality recreational opportunities for the campus community University Recreation Services programs include intramural sports, sports clubs, open recreation, outdoor recreation, special events, and recreation facility scheduling, and also provide assistance for other recreational services

For additional information, see *Student Life* section

Office of International Educational Services

Director: Martin Limbird, Lic. Sci Econ.

Assistant Directors: Dorothy Foley, M S ; Dennis Peterson, M A

Coordinator of Special Programs: John Greisberger, M.S.Ed.

Program Coordinators: Julie Rose, M.S.F S.; Margaretjean Weltha, M.A , Lorie Wardlaw, M A

Coordinator of International Services: Rebecca Matters

The Office of International Educational Services provides assistance, information, and programming for three principal groups. the nearly 2,000 foreign students, scholars, and short-term visitors on campus each year; the over 2,000 American students and faculty seeking advice on overseas work, study, and travel; the 100,000 Iowans who use items from other cultures which are available through the office Services to foreign nationals include group orientation activities and intercultural programs throughout their stay as well as advice and counseling on immigration, legal, and personal concerns. Seminars for overseas travelers are scheduled each semester in addition to individual counseling on overseas study, work, and travel opportunities and fellowships, such as Fulbright-Hays grants. Educational materials reflecting the cultures of 140 countries are developed and distributed by the International Resource Center to campus and state-wide community groups. Service to these three groups contributes to improving intercultural understanding on campus and throughout the state

Office of Student Life

Dean of Student Life: Jon C. Dalton, Ed.D.

Assistant Dean of Student Life: Augustine E. Wright, Ph D

Program Supervisor: James E. Moore, M.A.

Orientation Coordinator: Margaret A. Healey, M.A.

Handicapped Student Services Coordinator: Janet K Huss, M.S.E

Program Advisers: Clarinda M. Nelson, M.S., Barbara H. Snyder, M.S.

Program Adviser-Greek Affairs: Jan Schubert, M S

Coordinator of Women's Programs: Rachel Christensen, M.M.Ed

Alcohol Education Programmer: James M. Krafft, M S

The Office of Student Life administers several student service programs including university orientation, fraternities and sororities, student conduct and judicial boards, registration and advising for student organizations and activities, women's programs, alcohol educational programs, handicapped student services, student information services, and the student advocate service.

The Office of Student Life provides a wide range of educational programs for individuals and student groups on such topics as leadership, goal setting, values clarification, interpersonal communications, life planning, and organizational development.

Staff members advise numerous student organizations and activities, including the Government of the Student Body, Black Student Organization, the Greek system, and Campus Chest. The HELP Center, a student information service, is located in room 125 Memorial Union and is staffed by the Office of Student Life.

Financial Aid and Student Employment Office

Director: Jerome H. Sullivan, M.P.A.

Assistant Directors: Larry Dietz, M.S.; Richard Lephart, A.B.

Coordinators: Surjit K. Bhella, Ph.D.; Marta Burkgren, M.S.

Advisers: Delores Hawkins, B.S., Philip F. Hawkins, M.S.; Madelyn Peregrim, M.A.

The Financial Aid and Student Employment Office offers assistance with financial concerns. Scholarships, grants, loans, and part-time employment (work-study) are available singly or in various combinations to meet the difference between the amount the student and his or her parents can reasonably be expected to provide and the cost of attending the University.

Eligibility for financial aid is based on financial need as determined by the Family Financial Statement (FFS). Students should submit the FFS, including the Basic/Pell Grant section, by March 1 prior to the fall term of enrollment in order to receive priority consideration. Applications received after March 1 will be given secondary consideration and awarded if funds are available To be eligible for financial aid you must be a U.S. citizen or permanent resident, enrolled on at least a half-time basis, and making satisfactory academic progress toward a degree.

Consideration for financial aid is given for only one academic year. Therefore, it is necessary to complete a new FFS each year.

Where to Apply

Family Financial Statements and financial aid brochures with sample budgets are available upon request from the Financial Aid and Student Employment Office, Room 12, Beardshear Hall. High school counselors also have FFS forms. The Financial Aid Form (FAF) will be accepted in place of the FFS, although the FFS is preferred.

Brief Description of Financial Aid Programs

Financial aid programs generally consist of three types: gift aid (scholarships and grants), loans, and part-time employment.

I. Gift Aid

A. Scholarships

1. **Admission with Recognition and Award.** High school graduates in the upper five percent of their class and students transferring from an Iowa two-year college with a 3.50 grade-point average are recognized for their high academic performance by a certificate of recognition and a $100 award. These awards are made at the time of admission to the University. No application is necessary.

2. **ISU Scholarship/Grants.** These awards are based on need as determined by the Family Financial Statement. The FFS, including the Basic/Pell Grant section, must be completed in order to be considered.

3. **State of Iowa Scholarships.** Iowa residents can obtain information and application forms from high school counselors or by writing to the Iowa College Aid Commission, 201 Jewett Building, 9th and Grand, Des Moines, Iowa 50309.

4. College and Departmental Scholarships. A number of scholarships are awarded to deserving students. For further information on these scholarships, please consult the listings of scholarships by college in this catalog or write directly to the college for information.

5. National Merit Scholarship Program. Students who become finalists in the National Merit Scholar competition are eligible for scholarships offered by the Iowa State University Alumni Achievement Fund. Finalists may receive a maximum scholarship of half their financial need up to $2000 per year. Finalists who do not have financial need will receive a $1000 scholarship.

6. Other Scholarship Sources. Students are encouraged to pursue funds from local agencies and private organizations

B. Grants

1. Basic/Pell Grants. The maximum award under this federal program is $1900 if available funds permit. All undergraduate applicants for financial aid must apply for the Basic/Pell Grant by completing the Basic/Pell Grant section of either the FFS or FAF. FFS and FAF forms may be obtained from high school counselors and college financial aid offices.

2. Supplemental Educational Opportunity Grants (SEOG). An eligible undergraduate student may be awarded a grant of $200 to $2,000 on the basis of financial need. The FFS, including the Basic/Pell Grant section, must be completed in order to be considered.

3. Officer Education (ROTC) Financial Assistance Grants. All students enrolled in Advanced ROTC (third and fourth years) in the Army, Navy, and Air Force programs are provided a financial assistance grant of $100 per month for up to 10 months per year The Navy program also includes a 4-year program which provides $100 per month for up to 10 months per year For further information, contact the appropriate ROTC Department.

II. Loans

A. National Direct Student Loans (NDSL). An eligible student may borrow, on the basis of need during the first and second year of undergraduate study, $3,000. A maximum of $6,000 for total undergraduate study is allowed A total of $12,000 may be borrowed for undergraduate and graduate programs. Interest of 4 percent on the unpaid balance begins with repayment of the loan principal 6 months after ceasing enrollment. The repayment period can be extended over a period of 20 years, with repayment related to the borrower's income.

B. University Long-Term Loans (ULTL). Private donors contribute the funds for this loan which is awarded on the basis of need to undergraduate and graduate students. The interest rate of 4 percent begins with repayment of principal 6 months after ceasing enrollment. Deferment provisions are available in some instances. The FFS, including the Basic/Pell Grant section, must be completed in order to be considered.

C. Health Professions Loans and Scholarships. These programs are limited to those students accepted for enrollment in the College of Veterinary Medicine. The loan funds have a 7 percent interest rate. Deferment and cancellation provisions are available in some instances. An FFS is required.

D. University Short-Term Loans. Students enrolled and in need of temporary assistance to pay educational expenses may apply for this loan. The loan is available each semester and must be repaid before final examinations of the same semester Interest is computed daily at the monthly rate of 1 percent on the unpaid balance. Students who face unexpected emergency expenses may also apply for this loan.

Students enrolled or planning to enroll on less than half-time basis will be eligible for only the amount of tuition and fees assessed on the fee card and educational supplies. Both educational supplies and living expense amounts can be borrowed provided the student is full-time. Students interested should contact the Financial Aid and Student Employment Office for more information concerning loan limits and guidelines. Short-term loans are also available for part-time students on a reduced basis.

E. Federally Insured/Guaranteed Student Loans (FISL). Hometown banks, credit unions, and savings and loan associations provide funds through this program. The interest of 9 percent per year begins with principal payments 6 months after the student ceases to be enrolled on at least a half-time basis. Repayment will be made over a period ranging from 5 to 10 years or less depending upon the total amount borrowed Deferments are granted in some instances. Applications are available from the lender or from the Financial Aid and Student Employment Office.

III. Part-time Employment

Employment opportunities are available in which students may earn a portion of their educational expenses The student job board outside of 12 Beardshear is used for advertising part-time employment available to ISU students through the centralized Student Employment Service The College Work-Study Program and other university employment opportunities are the main sources of jobs, although off-campus and odd jobs are also posted. All students seeking on-campus employment should pick up a student employment verification card from the Financial Aid and Student Employment Office before looking for a job.

A. College Work-Study Program. The College Work-Study Program is a need-based program that permits students to be employed on campus or off campus with public or nonprofit agencies with a portion (up to 80 percent) of their total earnings paid by federal funds and the remainder by the employing department (or agency). Students participating in the College Work-Study Program must be awarded financial aid and must have employment eligibility as a part of their award package. The total financial aid award including work-study or any on-campus employment may not exceed the determined need. Students may work a maximum of 40 hours per week and placement counseling is available to students upon request by the Financial Aid and Student Employment Office. The FFS, including the Basic/Pell Grant section, must be completed in order to be considered.

B. University Student Employment. University employment is available to all students, with the employing department paying all of the wages. Students who are receiving financial aid should not begin any university employment without first consulting the Financial Aid and Student Employment Office. Many students who live in university residence halls apply for work in the food service to help meet the cost of room and board. Students interested in food service employment may apply directly to the Assistant Director of Residence in Charge of Food Service, Residence Department, Friley Hall, Iowa State University, Ames, Iowa 50012.

C. Off-Campus Employment. The off-campus employment program seeks part-time employment opportunities for students who would like to work while they are in school. Restaurants, hotels, service stations, and retail sales stores are examples of local employers that list positions with this program. These jobs are available to any ISU student, graduate or undergraduate, regardless of his/her financial need. Students receiving other forms of financial aid, however, may be limited to the amount that they can earn off-campus. Jobs are listed on a board outside the Financial Aid and Student Employment Office, Room 12, Beardshear Hall

All state and federal aid programs are subject to review by their respective governing agencies, and may be changed without notice.

IV. Other Financial Aid

Many other forms of financial aid are available to students who qualify, including Vocational Rehabilitation, Veterans Benefits, Aid to Dependent Children, and Social Security. For further information on these programs, contact the appropriate government office.

Military Officer Education (ROTC) Scholarships

Army

The Military Science Department offers 4-, 3-, and 2-year Army ROTC scholarships to qualified students on a competitive basis in virtually any academic discipline. These scholarships provide payment of tuition, books, laboratory fees, and supplies, and a cash subsistence allowance of $100 per month. For applications or additional information, contact the Military Science Department at Room 132 Armory or call 294-1852

Navy

The Naval Science Department offers two scholarship programs that include payment of full tuition, fees, and books, plus $100 a month These programs are as follows:

1 The NROTC 4-year scholarship.
2 The NROTC 2-year scholarship.

Information is available from the Naval Science Department, telephone 294-6050.

Air Force

The Air Force Aerospace Studies Department offers Air Force ROTC scholarships covering 4, 3, or 2 years of college which are available to qualified students. The scholarships provide payment of tuition, book fees, laboratory fees, and $100 a month.

Scholarships are available to students qualified in the pilot, navigator, and missile career fields and in certain technical academic majors.

Details on scholarship qualification application procedures and eligibility are available from the Department of Air Force Aerospace Studies, telephone 294-1716.

Student Life

University Recreation Services

The office of University Recreation Services is dedicated to the provision of quality recreational opportunities for the campus community. Programs include intramural sports, sports clubs, open recreation, outdoor recreation, special events, and recreation facility scheduling. Assistance for other recreational services is provided.

The open recreation program includes the opportunity for free physical sports activity in Beyer Hall, State Gymnasium, Armory, Physical Education Building (east campus), Hilton Coliseum, outdoor tennis courts near Beyer Hall and Physical Education Building, outdoor basketball courts near Beyer Hall, intramural fields east of the Towers and Maple-Willow-Larch Residence Halls, playfields north of Beyer Hall, and Clyde Williams Field.

The Outdoor Recreation Program is composed of four basic elements: the camping-outdoor equipment checkout program, the organized trip program; basic instruction activity workshops; the Outdoor Equipment and Resource Center All of these programs and activities are designed to provide opportunities for natural environment experiences. The George E Veenker Memorial Golf Course, with a new clubhouse, is located north of campus on Stange Road. Old 1 and 18 golf holes north of the Armory are open for ISU recreation golf use at no charge. For more information, drop in at the Outdoor Equipment and Resource Center, Room 43 in the Armory (294-8200).

The Sports Club Program is designed to serve individual interests in different sports club activities and is student oriented in every respect. Sports clubs offer team or individual physical recreational opportunities. Following are the 38 sports clubs: aikido, archery, backpacking, badminton, bowling, boxing, canoe, chess, cricket, cycle, cyclone sabres (fencing), dress blues, equestrian, flying, handball, hapkido, hockey, judo, lacrosse, mountaineering, parachute, pershing rifles, rifle and pistol, rodeo, rugby, sailing, scuba, shorin-ryu, ski, soccer, table tennis, tae-kwon-do karate, tennis, trap and skeet, volleyball, water polo, weightlifting and ISU whitewater association

These clubs offer instruction and competition at the local and intercollegiate levels Dues are set by the club members, and all clubs receive financial subsidy from the Government of the Student Body to enable students to participate regardless of their financial situation

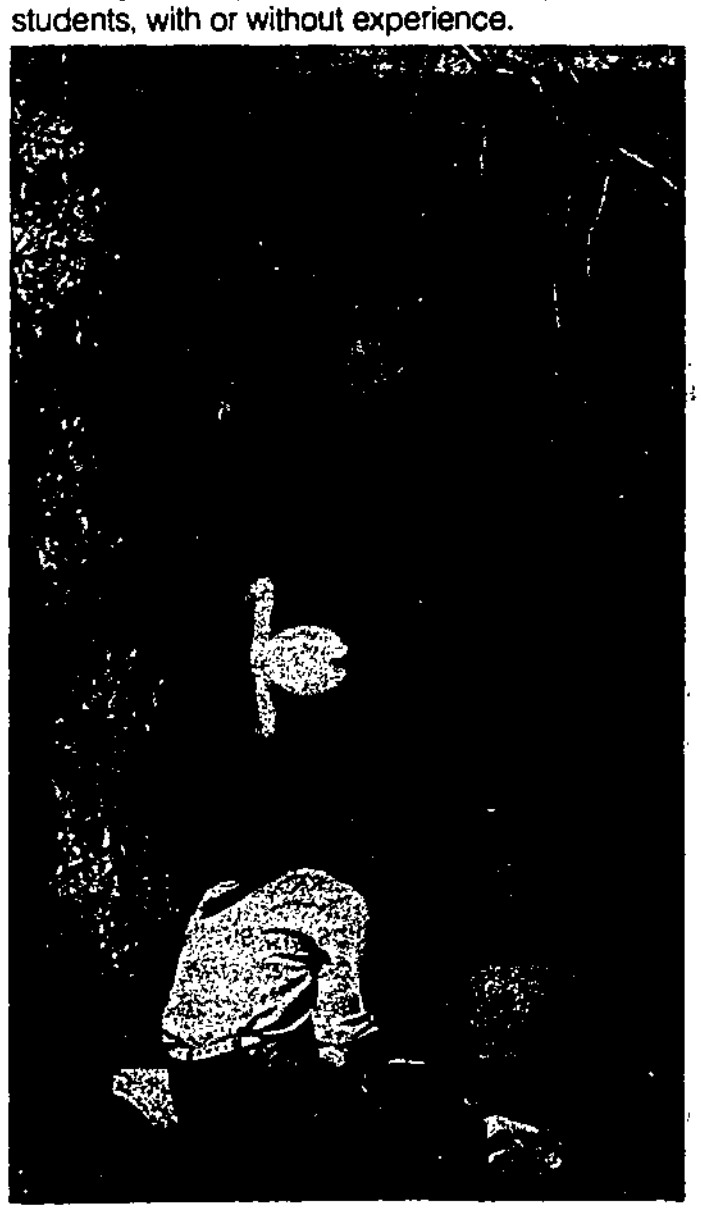
The intramural program involves competition among participants who enter as teams or individuals and play according to specific schedules. There are a total of 36 intramural activities ranging from football to innertube water basketball and curling.

Numerous special events add spice to the recreation program These activities are of an endless variety and usually take place in a short time span In general, they encompass demonstrations, performances, special contests, mass group participation, social occasions, excursions, displays or special instruction.

Other physical, cultural, and social recreation programs are sponsored in coordination with various departments, organizations, and groups on and off campus. For further information concerning campus recreation activity, contact the University Recreation Services office, 107 State Gym, or call 294-4980.

Forensics: Debate and Individual Events

The ISU forensics squad, sponsored by the Department of Speech, participates in several kinds of forensic activities. In addition to competing in intercollegiate debate and the full range of individual events (public address and oral interpretation), they provide service to professional and educational organizations. Each year the sqad travels over 30,000 miles to compete in approximately 35 tournaments. They sponsor both high school and college speech tournaments, in addition to on-campus public speaking activities The University is a member of the Iowa Intercollegiate Forensic Association, Twin Cities Forensic League, Missouri Valley Forensic League, the Cross Examination Debate Association, and has a chapter of Delta Sigma Rho-Tau Kappa Alpha, national forensics honorary. Participation in forensics is open to all students, with or without experience.



Lectures

During the academic year the University Lecture Series brings to the campus a number of speakers eminent in national and international affairs, the sciences, and the arts. In addition to giving formal lectures, a number of these speakers meet with students informally for discussions. Through these lectures and discussions the students are given a well-rounded presentation on subjects and areas affecting their culture, educational and economic philosophy, and scientific development. A World Affairs Institute, concentrating on one aspect of international interest and drawing on experts in the field, and a National Affairs Institute, concerned with a topic of current interest in the United States, are held each year. Focus, an annual fine arts festival with emphasis on student creativity in the arts, is held in the spring. From time to time University Lecture Series also sponsors or cosponsors dramatic, dance, and musical events.

The summer session is highlighted by a number of lectures on a wide range of topics by members of the faculty with expertise in the subject area they are addressing. In addition, some dramatic, dance, and musical events are scheduled.

Memorial Union

The Memorial Union is the center of much informal education on campus. It is a meeting place and headquarters for most of the larger student organizations. Dances, banquets, lectures, concerts, shows, exhibits, and other large campus gatherings are accommodated in its meeting halls and ballrooms. Recreational facilities include bowling alleys, table tennis, billiards, television, and a music listening room, as well as quiet lounges and a browsing library. A small chapel occupies one corner of the building.

A cafeteria, private dining rooms, a restaurant, and a snack bar cater to guests of the University as well as to students and faculty. The Maintenance Shop Bar is an informal gathering spot for students and faculty; weekends feature live entertainment. The Crafts Center has facilities and materials for individuals to express themselves creatively and the Outlet is a place to buy and sell original art work. Overnight guest rooms may be occupied by campus visitors. The Memorial Union also has a complete book store.

Launched by alumni as a memorial to the service of sons and daughters of the University in World War I, the Memorial Union has now become a memorial to all Iowa State men and women who have served in the armed forces of our country. Replacement cost of the building is nearly $15 million. The Memorial Union is owned and operated by students and alumni of Iowa State and is financed from dues and from fees received for services.

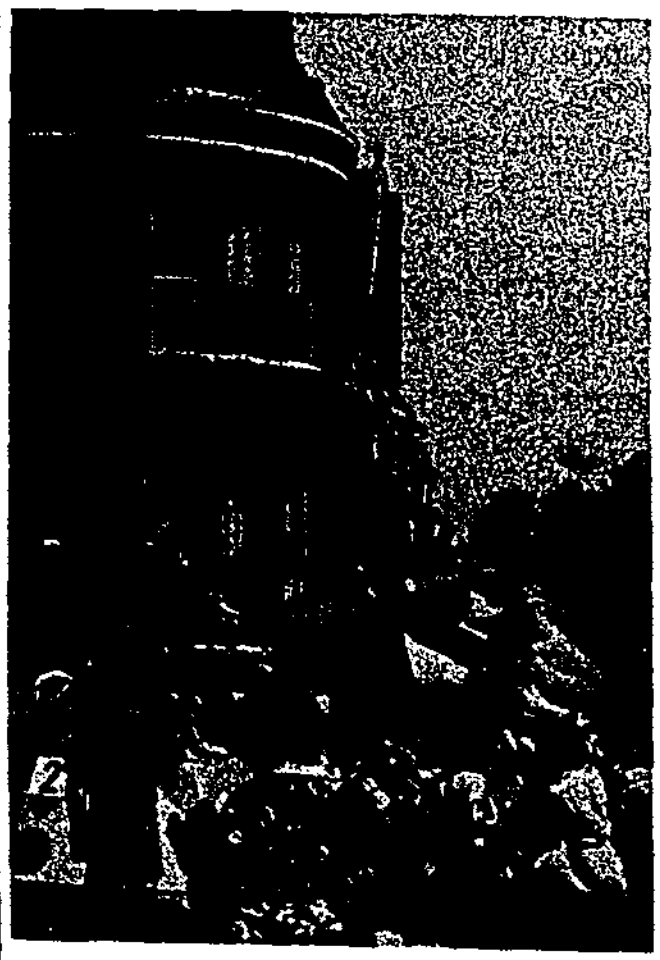
Music Activities

Many opportunities to perform and listen to music are provided Iowa State students. The Department of Music offers a full instructional program including applied vocal and instrumental instruction, music theory, music history and literature, and music education.

Large student performing organizations include several choruses, bands, and the ISU Symphony Orchestra. Smaller student ensembles include Chamber Singers, Musica Antiqua, Opera Studio, Jazz Ensemble, and Cardinal Keynotes. In addition to Brass Choir, wind players have the opportunity to perform in several brass and woodwind ensembles. Campus concerts, student operas, musical shows, the Christmas Festival of Music, the Madrigal Dinner, and concert tours are among the musical events offered.

Several concert series such as the Music, Variety, Dance, Theater, Young Concert Artists, and Town and Gown Chamber Music, bring professional performers of high caliber to the campus and the city of Ames. The Ames International Orchestra Festival has received worldwide acclaim for annually bringing at least one major symphony orchestra to Ames for a series of concerts. In addition, many members of the music faculty appear in recitals.

Sigma Alpha Iota and Phi Mu Alpha, professional music fraternities for women and men, are represented on campus.



Honor and Professional Organizations

Iowa State University has chapters of 32 national honor societies, which elect members primarily on achievement in scholarship or research. Those which elect students from a college or from the University at large are:

- Alpha Lambda Delta — first-year students
- Alpha Zeta — Agriculture
- Gamma Sigma Delta — Agriculture
- Kappa Delta Pi — Education
- Omicron Nu — Home Economics
- Phi Beta Kappa — Sciences and Humanities
- Phi Delta Kappa — Education
- Phi Eta Sigma — first-year students
- Phi Kappa Phi — all-university
- Phi Upsilon Omicron — Home Economics
- Phi Zeta — Veterinary Medicine
- Sigma Xi — Science
- Tau Beta Pi — Engineering

Professional societies choose their members from students, with special departmental affiliations, who meet scholastic and character requirements. Most curricula of the University have such professional societies. There are also departmental clubs and organizations that meet special interests.

Activities honoraries focus their requirements for membership on the basis of interest, participation, or special achievements in all-university activities. Mortar Board and Cardinal Key are the highest activities honoraries. Both groups select members on leadership, service to Iowa State, scholarship, and character. Several other activities honoraries recognize students in various special areas.

Religious Life

Iowa State is a state-supported, nonsectarian institution, but it recognizes the importance of spiritual life and cooperates with the many off-campus groups that fulfill the religious needs of the community.

Most of the larger denominations have churches within easy walking distance of the campus. A number of these have built attractive student centers in connection with the churches and conduct extensive student programs under the direction of professionally trained persons. In addition, a number of campus student organizations also address the religious needs of many students.

YWCA and YMCA

The YWCA and YMCA are located in Alumni Hall, near central campus. They design programs which bring students to active participation in campus and community life and challenge them to a deeper exploration of their value commitments.

Theatre and Dramatics

The Iowa State University Theatre, Department of Speech, produces a season of at least five major presentations each year. The season's bill endeavors to offer a variety of theatrical fare, including a musical, a children's play, well-known dramatic literature and unusual and lesser-known plays. Practial experience in all phases of theatrical production is open to all interested, registered students within the University. The season is partially subsidized by an allocation from the Government of the Student Body; therefore, all students paying activity fees may attend a performance upon presentation of their activity fee card plus a small validation charge.

Other theatre-sponsored programs include Speech 555, directing practicum; Shattuck Players; student-produced plays; readers theatre programs; I-Alum, a local theatre honorary; Theta Alpha Phi, a national dramatics honorary; and a summer theatre program.

Fraternities and Sororities

The 32 fraternities and 16 sororities at Iowa State University have approximately 3,100 student members (2,000 men and 1,100 women). Combined, they provide housing facilities for 2,700 undergraduate students at Iowa State.

The chapter house facilities are similar to a private residence — living room, den, kitchen, dining room, laundry room, etc. Local alumni work with each fraternity and sorority to ensure that the chapter structure meets all the state and local building, safety, and fire codes that are required with incorporation under the State Law of Iowa. These alumni also assure that the

chapter is meeting the educational objectives of the University and the individual chapter

The cost of living in a fraternity (room, board and social dues) averages $870 each semester Initiation fees (paid once for life) range from $25 to $40 for a pledging fee, and $60 to $140 for the activation fee. Freshmen men move directly into the fraternity house as the academic year begins and generally remain throughout their college career.

Sororities at Iowa State University have an average house bill of $825 per semester for room, board, and social dues. Pledging fees vary from $20 to $45 (average: $26.75) Initiation fees average a one-time cost of $80, with an additional cost of a sorority pin. Some houses include the pin in initiation dues, making the average cost about $111.

Freshmen women pledged during formal rush or informally throughout the year generally live in the residence halls for the academic year. However, as chapter space allows, there is an option for freshmen and upperclass women to move into their sorority house upon invitation by the chapter, providing they abide by their residence hall contracts.

Activities include Interfraternity Council, Panhellenic Council, Greek Week, Greek Programming Committee, various task forces on fraternity/sorority issues, as well as each individual chapter leadership.

Fraternities and sororities have been active with Iowa State University since 1875. Since that time, over one-third of Iowa State's total alumni have graduated with fraternity/sorority affiliation.

Student Conduct

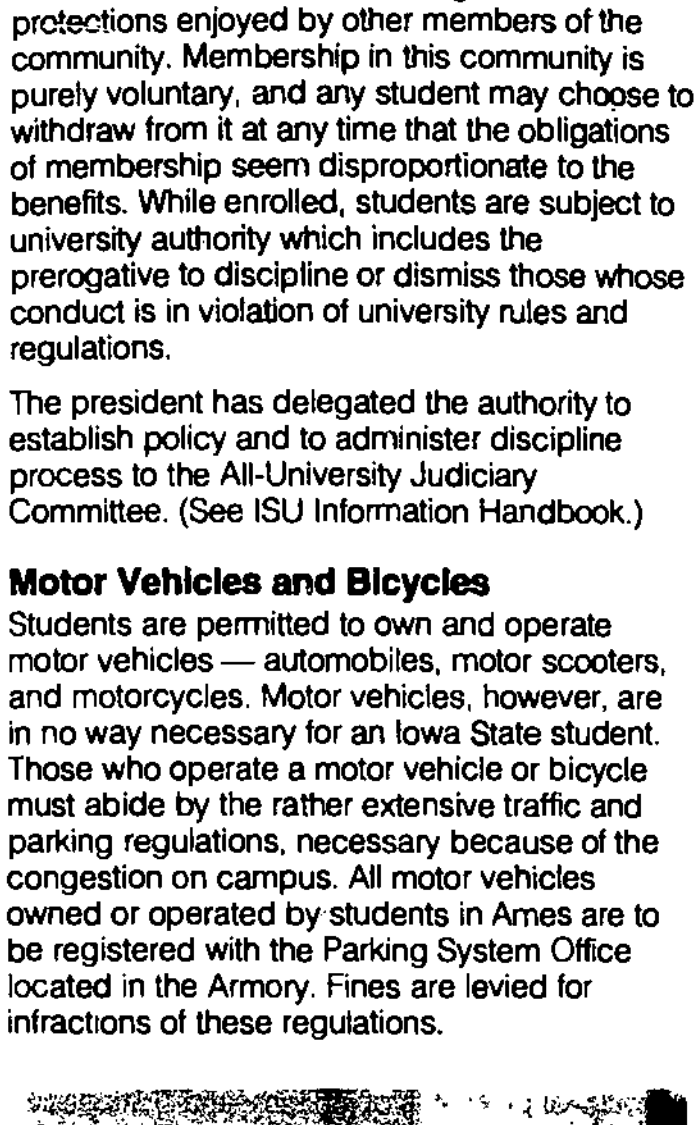
Iowa State students are expected to seriously pursue their educational goals and conduct themselves in a manner that preserves an appropriate atmosphere of learning. All students who enroll at Iowa State are expected to assume the responsibilities of citizenship in the campus community.

As a citizen of this academic community, students are entitled to all the rights and protections enjoyed by other members of the community. Membership in this community is purely voluntary, and any student may choose to withdraw from it at any time that the obligations of membership seem disproportionate to the benefits. While enrolled, students are subject to university authority which includes the prerogative to discipline or dismiss those whose conduct is in violation of university rules and regulations.

The president has delegated the authority to establish policy and to administer discipline process to the All-University Judiciary Committee. (See ISU Information Handbook.)

Motor Vehicles and Bicycles

Students are permitted to own and operate motor vehicles — automobiles, motor scooters, and motorcycles. Motor vehicles, however, are in no way necessary for an Iowa State student. Those who operate a motor vehicle or bicycle must abide by the rather extensive traffic and parking regulations, necessary because of the congestion on campus. All motor vehicles owned or operated by students in Ames are to be registered with the Parking System Office located in the Armory. Fines are levied for infractions of these regulations.



Child Care/Nursery School/Day Care

A variety of child care programs (homes and centers), nursery schools, and babysitting services are available in Ames to meet the diverse needs of parents and children. Cost for full child care ranges from $6.00 to $12.00 a day. Some programs serve infants and school-age children but care for these age groups is relatively scarce. Some programs, particularly university sponsored and subsidized non-profit programs, have waiting lists. Information about specific programs and prices is included in *A Guide to Child Care in Ames,* available free from the Ames Chamber of Commerce (232-2310), Department of Child Development (294-3040), University Student Apartments (294-5360), and the YWCA (294-1663).

Research and Service Agencies

Research is an important activity at Iowa State. Most faculty members engage in research pursuits as well as teaching. Graduate students, and in some cases undergraduates, receive stimulation which comes from being a part of the never-ending search for new knowledge. Therefore, new developments and new ideas pervade the campus.

A year's operating budget for all research at the University is approximately $53 million, much of it from contracts or grants involving the federal government and industry.

As part of its total program the University also operates extension services, special laboratories, and institutes.

An abbreviated description of the various research and service agencies and their administrative personnel is presented here. Additional information concerning any of these organizations may be obtained from the offices located on the campus.

Agriculture and Home Economics Experiment Station — Lee R. Kolmer, director; John P. Mahlstede, associate director; Ruth E Deacon, Thamon E. Hazen, Ronald C. Powers, assistant directors. Experimental work is conducted at Ames, twelve outlying research centers, and in the fields of many farmer cooperators Programs include both basic and applied research in agriculture and home economics.

Ames Laboratory of the United States Department of Energy — Robert S Hansen, director; Velmer A. Fassel, deputy director, Eugene Catus, associate director; William J Kernan, associate director; Kenneth L. Kliewer, associate director; Adolf F. Voigt, assistant director. The Laboratory staff conducts basic investigations that seek to discover new scientific knowledge and improve understanding of natural laws and phenomena related to energy conversion technologies. The Laboratory prepares scientists for work through research appointments to Iowa State University graduate students.

Center for Agricultural and Rural Development — Earl O. Heady, director. The staff conducts research and related activities relating policy to income, employment, the structure and development of agriculture, resources, the environment, and rural communities both domestically and internationally.

Computation Center — Clair G. Maple, director; Dale D. Grosvenor, associate director; Robert J. Lambert, associate director; George O. Strawn, associate director; Michael D. Bowman, assistant to the director; George F. Covert, assistant director, systems; John B. Linderblood, assistant director, operations; Jerome Niebaum, assistant director, interactive computing. The Center provides an all-university computing service and a centralized facility for research and education in the computer sciences.

Energy and Mineral Resources Research Institute — Robert S. Hansen, director; Velmer A. Fassel, deputy director; Eugene Catus, associate director; William J. Kernan, associate director; Kenneth L. Kliewer, associate director; Adolf F. Voigt, assistant director. The institute coordinates and administers energy-related research programs, most extensively federally-funded projects (through the Ames Laboratory) and state-funded activities such as the Iowa Coal Project.

Engineering Research Institute — D. R. Boylan, director. The Institute coordinates staff research in areas involving all engineering academic departments and maintains major laboratories and technical service groups to support the various research programs. Funds are derived from state appropriations and from industrial and government grants or contracts. Activity is largely directed toward graduate instruction.

Home Economics Research Institute — Ruth Deacon, director. The staff of the Institute promotes and conducts research as a part of the various programs in the College of Home Economics.

Industrial Relations Center — Paul M. Muchinsky, director. The central focus of research is on the behavior of individuals and organizations in an employment and labor force relationship. It provides an interdisciplinary approach to related studies.

North Central Regional Center for Rural Development — Ronald C. Powers, director. The Center is supported by the land-grant universities of the North Central Region and the U.S. Department of Agriculture. The major purpose of the Center is to conduct a multi-disciplined research and extension program addressed to improving the social and economic opportunities of both farm and nonfarm people of nonmetropolitan, or rural, America.

Nutritional Sciences Council — Jerry W. Young, chairman. The Nutritional Sciences Council consists of faculty members and qualified collaborators who are engaged in research, extension, or teaching in the nutritional sciences and closely related disciplines. Tha Council develops symposia on topics of international interest, sponsors an interdepartmental seminar, "Modern Views of Nutrition," and arranges short courses designed to fill specific needs in the total nutrition program.

Research Institute for Studies in Education — Richard D. Warren, director. The Institute coordinates and conducts research directly concerned with, but not limited to, educational personnel development in the major areas of elementary, secondary, higher, and continuing education. Its research functions interface with other programs in the College of Education· in-service development, extension services, and service programs to school districts, area schools, community colleges, the State Department of Public Instruction, regional education centers, and national research and development centers.

Sciences and Humanities Research Institute — Wallace A. Russell, director; Thomas W. Tumage, associate director. Research programs in the College of Sciences and Humanities are sponsored, coordinated, and administered through the Sciences and Humanities Research Institute. Its primary objective is to encourage basic research and creative scholarship in the five major areas included in the college — the humanities, the social sciences, the biological sciences, the physical sciences, and the mathematical disciplines. These activities are carried out, with support from the Institute, by faculty members of the college and by graduate students working in these areas. In addition, the Institute works closely with other research agencies, both on campus and off, and administers externally funded sponsored research within the college.

In extending the frontiers of knowledge, these activities contribute directly to the University's educational mission. In addition, they provide ideas and results which may aid in the solution of both present and future problems of the state and the nation.

Soil Science Institute — Wayne H Scholtes, director. The Soil Science Institute is a multidisciplinary institute with the objective of conducting instruction of the most current information in the subject-matter areas supportive to the field of soil genesis and classification. Since its inception at Iowa State University in 1966, it has been offered every other year for selected soil scientists from the U.S. Department of Agriculture.

Statistical Laboratory — Herbert A. David, director. A research and service institute which conducts research in statistical theory and methodology. It promotes and fosters the use of sound statistical methods in university research through on-campus consulting.

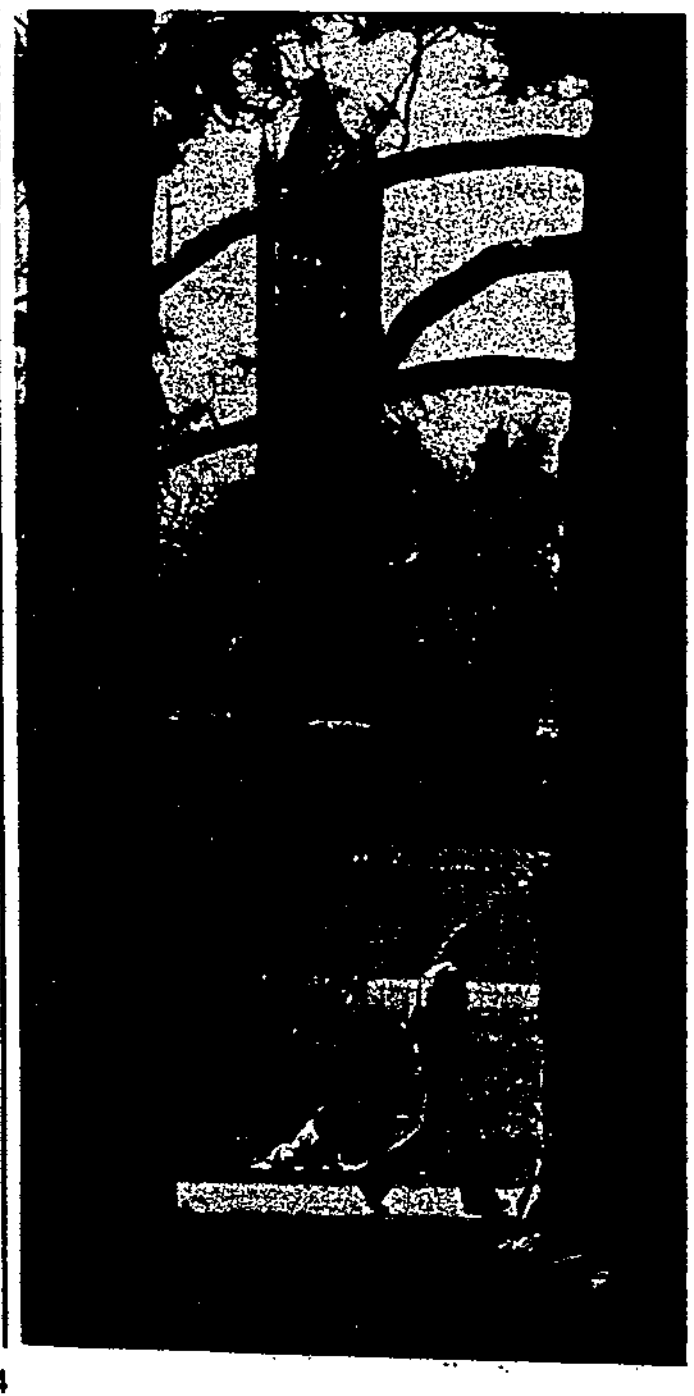
Veterinary Medical Diagnostic Laboratory — Vaughn A. Seaton, head. The laboratory provides a facility to which the Iowa animal industry and veterinary medical profession can bring animal health problems for counsel and diagnostic assistance.

Veterinary Medical Research Institute — Phillip T. Pearson, director; Melvin S. Hofstad, professor in charge. The Institute is multi-disciplinary with a responsibility to conduct research and offer research training in animal diseases. Research and research training are conducted in the areas of viral, bacterial and parasitic diseases, immunology and basic biology.

Water Resources Research Institute — Merwin D. Dougal, director; Daniel J. Zaffarano, administrative coordinator. The Institute coordinates and administers an interdisciplinary program in water resources research. It administers the federal funds received from the Office of Water Research and Technology, U.S Department of the Interior, as made available through the Water Resources Research Act of 1978, as amended. Funds received from private, state, and federal sources are allocated for research in all aspects of water resources, directed primarily at solving state, regional, and national water problems Graduate research training, technology transfer, and information dissemination are additional elements of the program.

World Food Institute — Charlotte E Roderuck, director The World Food Institute of Iowa State University was officially established in 1972 by the Iowa Board of Regents to focus Iowa State University's competencies and leadership upon the provision of adequate and nutritious food supplies for the world's peoples through research and education The World Food Institute's five major goals are (1) To analyze food and nutrition problems; (2) To generate solutions to food and nutrition problems and to suggest means for implementation of solutions, (3) To build competencies in people for the generation and implementation of solutions of food and nutrition problems; (4) To collect, analyze, and disseminate information bearing on food and nutrition problems; and (5) To study interrelationships between the United States, with particular emphasis on Iowa, and other countries of the world.

The Institute sponsors an undergraduate course on world food problems through University Studies, seminars, faculty projects, an annual World Food Institute lecture, WFI Distinguished Foreign Scholars, and WFI International Fellows.



University Extension

Charles E. Donhowe, Dean

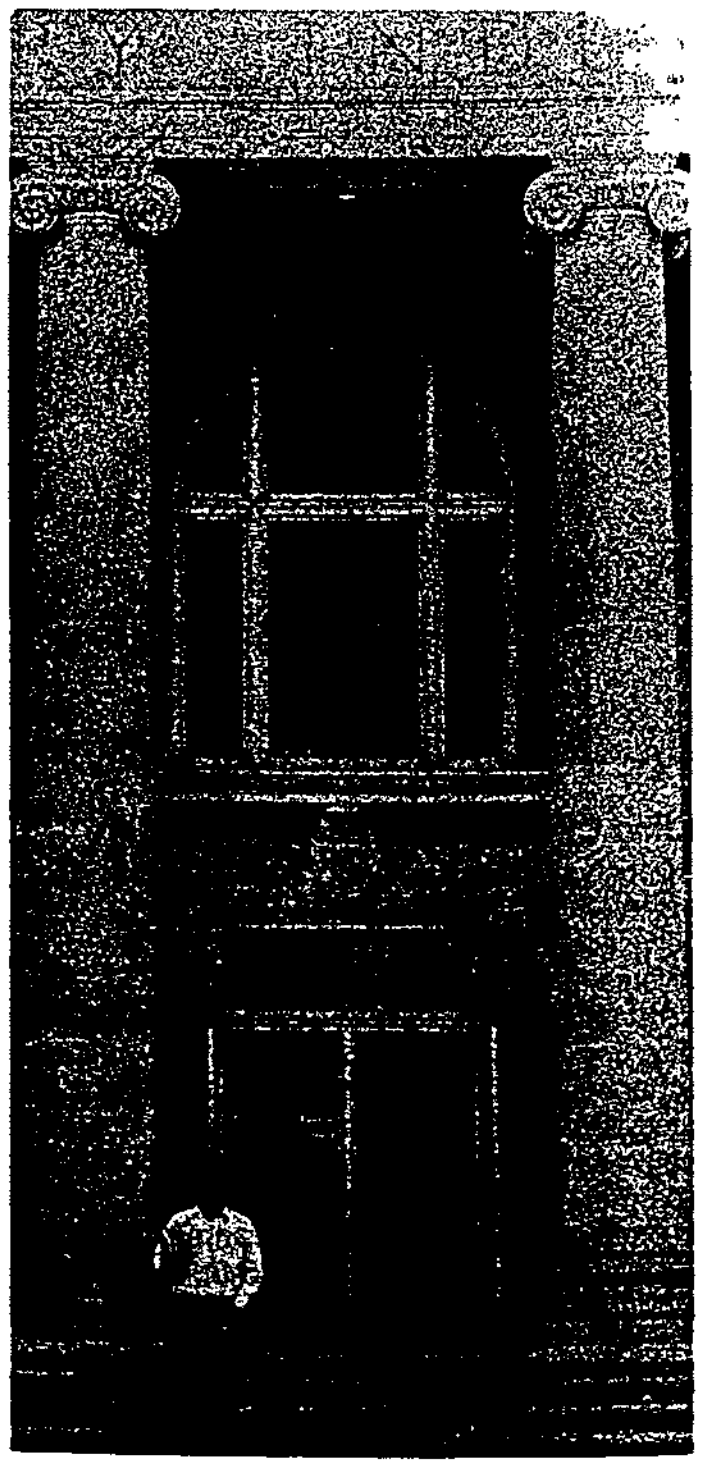
Through the combined University Extension program, the total resources of Iowa State can be brought to bear on urban and rural problems University Extension includes all extension programs emanating from Iowa State. Most of the efforts are organized through the extension units.

Cooperative Extension Service in Agriculture and Home Economics — Charles E. Donhowe, director. Among the programs offered are agricultural production, conservation of national resources, efficient marketing and distribution of farm-raised products, family living, 4-H club work, youth development, community improvement and resource development.

Engineering Extension — R. E. Patterson, Jr , director. Both non-credit courses and video-taped graduate-credit courses taught by faculty members from the College of Engineering are offered throughout the state.

Center for Industrial Research and Service (CIRAS) — David H. Swanson, director. An advisory service to Iowa industry and business The center facilitates the dissemination of counsel and assistance in solving the operational problems of industry and business in the private sector.

Office of Continuing Education — George H Ebert, leader. Extension courses, off-campus university credit courses, and informal continuing education programs are offered as part of the broad educational and service base of the University.



Colleges and Curricula

The University is organized into eight colleges, including the Graduate College. These colleges offer degree programs in the following curricula and majors (For a complete list of majors at the graduate level, see the summary at the end of the *Graduate College* section of this catalog)

The main academic programs of each college are listed here, together with the degrees or certificates awarded upon completion In many cases certain majors, options, or electives allow for increased specialization within the programs Programs which are administered jointly by two colleges are listed within both colleges

College of Agriculture

Agricultural Biochemistry, B S
Agricultural Business, B S
Agricultural Economics, M S , Ph.D.
Agricultural Education, B.S , M S , Ph D
Agricultural Engineering, B S., M.Eng , M S , Ph D.
Agricultural Extension Education, B S
Agricultural Journalism, B S , M S
Agricultural Mechanization, B S
Agriculture, M Agr
Agronomy, B S , M S , Ph D
Animal Ecology, B.S , M S , Ph D
Animal Science, B S , M S , Ph D
Biometry, B S
Dairy Science, B S.
Entomology, B.S., M.S., Ph D
Farm Operation, B.S
Fisheries and Wildlife Biology, B S , M S , Ph D
Food Technology, B S , M.S., Ph D
Forestry, B S., M.S., Ph.D.
Genetics, M.S., Ph D.
Horticulture, B.S., M.S., Ph.D.
International Agriculture, B.S.
International Studies, B.S.
Pest Management, B S.
Plant Pathology, B.S., M.S., Ph.D.
Public Service and Administration in Agriculture, B.S.
Rural Sociology, M S., Ph D
Seed Science, B S

College of Design

Art and Design, B A , B F A , M A
Architecture, B.A., B Arch , M Arch
Community and Regional Planning, B S , M.C.R.P
Landscape Architecture, B L.A., M L A.

College of Education

Education, M.Ed., M.S., Ph.D.
Elementary Education, B.S.
Environmental Studies, B.S.
Industrial Education, B.S., M.Ed., M.S., Ph.D.
Leisure Studies, B.A.
Physical Education, B.S., M.S.
Secondary Education (See certification programs offered by the colleges of Agriculture, Design, Home Economics, and Sciences and Humanities.)

College of Engineering

Aerospace Engineering, B S , M.Eng , M.S., Ph D.
Agricultural Engineering, B.S , M Eng , M S , Ph.D.
Chemical Engineering, B.S., M.Eng , M.S., Ph D
Civil Engineering, B.S., M.S.
  Construction Engineering, B.S.
  Geodesy and Photogrammetry, M.S
  Geotechnical Engineering, M.S., Ph D
  Municipal Engineering, M S.
  Sanitary Engineering, M.S., Ph.D.
  Structural Engineering, M.S., Ph.D.
  Surveying, B.S.
  Transportation Engineering, M.S , Ph.D.
Electrical Engineering, B.S., M. Eng., M.S., Ph.D.
  Computer Engineering, B.S.
Engineering Mechanics, M.Eng., M.S , Ph.D
Engineering Science, B.S.
Industrial Engineering, B.S., M. Eng., M.S.
  Engineering Journalism, B.S
  Engineering Operations, B S
  Engineering Valuation, M.Eng , M S., Ph.D
Materials Science and Engineering, M.Eng.
  Ceramic Engineering, B.S , M.S , Ph.D.
  Metallurgical Engineering, B.S
  Metallurgy, B S , M S , Ph D
Mechanical Engineering, B S , M S , Ph D
Nuclear Engineering, B S , M Eng , M S , Ph D

College of Home Economics

Child Development, B S , M S , Ph D
Family Environment, B S , M S , Ph D
Food and Nutrition, B.S , M.S., Ph.D
Home Economics Education, B S , M S , Ph D
Home Economics Journalism, B.S.
Home Economics Studies, B.S.
Institution Management, B.S., M S , Ph.D
Textiles and Clothing, B.S., M.S

College of Sciences and Humanities

Anthropology, B.A., B.S., M.A.
Biochemistry, B.S., M.S., Ph.D.
Biology, B.S.
Biophysics, B.S., M.S., Ph.D.
Botany, B.S., M.S., Ph.D.
Business Administration, B.B.A., B.S.
  Accounting, B.B.A.
  Finance, B.B.A.
  Management, B.B.A.
  Marketing, B B A
  Transportation/Logistics, B.B.A.
Chemistry, B.A., B S , M.S., Ph.D.
Computer Science, B.S , M.S , Ph.D.
Distributed Studies, B.A., B.S.
Earth Science, B.A., B.S., M.S., Ph.D.
  Geology, B.A., B.S., M.S., Ph.D.
  Meteorology, B.A., B S., M.S., Ph.D.
Economics, B.A., B.S., M.S., Ph.D.
English, B.A., B.S., M.A.
Environmental Studies, B.A., B.S
Foreign Languages and Literatures
  French, B.A.
  German, B.A.
  Russian, B.A.
  Spanish, B.A.
History, B.A., B.S., M.A.
  History of Technology and Science, M.A., Ph.D.
Individual Major, B.A., B.S.
International Studies, B.A., B.S.
Journalism and Mass Communication, B.A., B.S., M.S.
Liberal Studies, B.L.S.
Mathematics, B.S., M.S., Ph.D.
Metallurgy, B.S., M.S., Ph.D.
Microbiology, B.S., M.S., Ph D.
Music, B.A., B.Mus.
Naval Science, B.S.
Philosophy, B.A.
Physics, B.S., M.S., Ph.D.
Political Science, B.A., M.A., M.P.A.
Psychology, B.S., M.S., Specialist, Ph.D.
Sociology, B.A., B.S., M.S., Ph.D.
Speech, B.A., B.S.
Statistics, B.S., M.S., Ph.D.
Zoology, B.S., M.S., Ph.D.

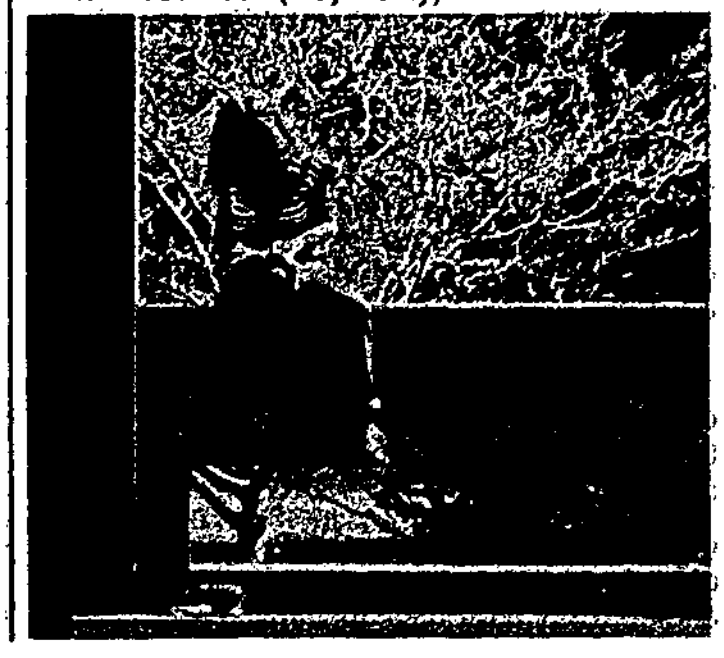
College of Veterinary Medicine

Veterinary Anatomy, M.S , Ph.D.
Veterinary Clinical Sciences, M.S.
Veterinary Medicine, D.V.M.
Veterinary Microbiology, M.S., Ph.D.
Veterinary Pathology, M.S., Ph.D.
Veterinary Physiology, M.S., Ph.D.
Veterinary Preventive Medicine, M.S.

Graduate College

The Graduate College administers the graduate programs listed above, as well as the following interdepartmental programs:

Biomedical Engineering, M.S., Ph.D.
Energy Systems Engineering (minor only)
General Graduate Studies, M.A., M.S.
Gerontology (minor only)
Housing (minor only)
Immunobiology, M.S., Ph.D.
Industrial Administrative Sciences, M.S.
Industrial Relations, M.S.
Molecular, Cellular, and Developmental Biology (major only)
Technology and Social Change (minor only)
Transportation Planning, M.S.
Water Resources (major only)



Bachelor's Degree Requirements

A cumulative quality-point average of at least 2.00 in all work taken at Iowa State University is required for graduation.

A student admitted as a transfer from another college or university to Iowa State is required to have a 2.00 cumulative average. A student may, however, be admitted with a quality-point deficiency, but will be required to earn sufficient quality points above a 2.00 at Iowa State to offset the quality-point deficiency at the time of entrance.

A student who takes work at another college or university after having been enrolled at Iowa State must submit transcripts of all work attempted to the Office of Admissions at Iowa State. This work must average a 2.00 or the deficiency of quality points will be assessed against the student. Failure to submit such transcripts will be grounds for dismissal.

In unusual circumstances, the academic standards committees of the respective colleges may review and give further consideration to the records of students who, except for grade-point average, have satisfactorily completed all graduation requirements. If the appropriate college academic standards committee considers that the educational and professional needs of such a student have been satisfactorily met, or can be satisifactorily met by imposing further conditions, then the committee may recommend to the dean of the college that the student be graduated or that a supplemental program be accepted in place of the fully unqualified grade-point average. The college academic standards committee chairperson reports such excaptional actions to the University Academic Standards Committee.

The final 32 credits must be taken in residence at Iowa State University in order to qualify for the baccalaureate degree, although six of the last 32 credits may be transferred to Iowa State if applied as electives and earned at a four-year college

A student may receive two bachelor's degrees if he or she meets the requirements of each curriculum and earns at least 30 credits beyond the requirements of the curriculum requiring the greater number of credits. Each degree program must be approved by the appropriate department chair or head.

A student fulfilling the requirements of two separate curricula in different colleges may, in certain cases, receive a degree from one of the colleges with double majors crossing college lines. The permissions of both deans must be obtained and each degree program must be approved by the appropriate department and dean.

English Proficiency Policy

Iowa State University believes that written communication is a fundamental skill of an educated person; therefore its graduates are expected to acquire reasonable competence in written communication during their educational careers. The following are designed to insure that this competence is developed and maintained:

(1) All students must earn credit in a sequence of basic composition courses, (e.g., English 104 and 105), normally in the freshman year.

(2) Continued development of communication skills following the freshman year is the responsibility of the student's major department. This development may be promoted by requiring and critically evaluating term papers and other written assignments as part of courses offered by the department and by encouraging students to enroll in advanced English composition courses which meet their particular needs.

(3) Each department is responsible for certifying that its majors have achieved an adequate level of proficiency in written communication at the time of graduation.

English Requirement for International Students

International students whose first language is not English must demonstrate ability to study in this English-speaking university. Such students — beginning as well as those who transfer from other institutions — must take an English placement test when they arrive on campus. The test is administered by the English Department and is offered at the opening of each semester.

Students whose performance on this placement examination is satisfactory will follow the regular English requirements of their major department. Students who have deficiencies will enroll in special English classes (as determined by the test results).

International students transferring from other U.S. colleges or universities who offer transfer credits for English 104-105 must also meet the above requirements before such credits can be applied.

Library Study

Independent study and investigation through the use of books and libraries enable students to grow intellectually and professionally in college and afterward. For this reason, all students receive instruction in the use of the University Library, including practice in how to locate the published literature of their respective fields of study.

Curriculum Requirements

The curriculum requirements both in number of credit hours and specific courses are guidelines for the student and his or her adviser in planning an academic program. The curriculum is subject to change and because of these changes, adjustments may need to be made.

Catalog in Effect

A student may choose to graduate under the catalog in effect at the time of graduation, or one of the two immediately preceding catalogs, provided it covers a period of his or her enrollment. Full requirements of the chosen catalog must be met except that adjustments will be made in instances where courses are no longer available or where programs have been changed.

Special Recognitions

The Dean's List, issued in spring for students enrolled the fall semester and in summer for students enrolled the spring semester, recognizes undergraduate students who have been enrolled for 15 or more hours (excluding "P" and "I" marks) during the semester and have earned a quality-point average of 3.50 or higher.

High scholarship is recognized at graduation. Undergraduate students who have a cumulative quality-point average of 3.50 or above are eligible to graduate with distinction. The quality-point average upon which graduation with distinction is determined includes all work undertaken at Iowa State prior to the opening of the term in which the student receives his or her degree.

Each spring the University recognizes high scholarship students at the annual Scholarship Recognition Dinners. Those students who rank in the top 2 percent of each class in all colleges and the senior who is graduating "with distinction" and has attained the highest grade-point average in her or his curriculum or major are honored. Special recognition is also given to the graduating senior in each college with the highest average.

Many special awards, established by professional groups, alumni, and others interested in the University, are presented annually in recognition of academic attainment and noteworthy achievements in other areas of campus life. Information about awards offered in the various colleges is available through the offices of the respective deans.

Special Programs

Honors Program

The Iowa State University Honors Program is designed for students who have demonstrated the ability and maturity to assume more than the usual responsibility for their undergraduate education. Students in the Honors Program determine their educational objectives and devise an individualized program of study to meet these objectives. An Honors program may include substitutions for required courses, combinations of courses from several departments to form a new major or minor, Honors courses and seminars, independent study and research, and other forms of innovation. The goal is to enable Honors students to gain maximal benefit from their undergraduate education.

Each undergraduate college operates its own Honors Program. The college committees admit students into the program, approve programs of study, and are responsible for administration of their college Honors Program. The University Honors Program Committee, which includes the chairpersons of each college program, is responsible for the general coordination of the University Honors Program.

Special educational opportunities. Honors courses, open only to Honors Program students, and Honors sections of regular courses are offered by various departments. These courses have limited enrollment and are taught by specially selected instructors. An Honors student may also have any course designated as an Honors course by making appropriate arrangements with the course instructor.

The University Honors Program organizes Honors seminars which are open only to Honors Program students. These seminars, which have limited enrollments and are offered only on a satisfactory-fail basis, are listed under University Studies 321 and 322.

A listing of Honors courses and seminars for the current academic year may be obtained from the Honors Program office.

Most departments offer opportunities for independent study and research under 290 or 490. When designated by an H, these courses carry Honors credit. Research grants are available to support Honors research.

Eligibility. Students become eligible to apply for admission to the Honors Program during their second semester in residence and continue to be eligible for admission as long as they have at least 48 semester credits remaining before graduation. Admission is based on the student's grade-point average and other evidence of exceptional ability and potential. Decisions with respect to admission are made by the college Honors Program committees

Freshman Honors Program. Entering freshmen with outstanding high school records and academic ability may be eligible to participate in the Freshman Honors Program. The Freshman Honors Program, which is designed to introduce students to an Honors education, consists of special Honors sections of English 105 and other freshman courses, a Freshman Honors Seminar, and advising by specially selected Honors advisers. Admission is limited and by invitation and is based on past academic achievement, potential, and interest in an Honors education

Further information. Further information concerning the University Honors Program and the Freshman Honors Program can be obtained from the Honors Program Office in Osborn Cottage

Seminar Eighties

The Seminar Eighties program is designed to promote the analysis and discussion of current issues Supervised by a faculty-student advisory committee, seminars are offered each semester under University Studies 311 and 312 Each seminar meets once a week, and students are awarded one hour of academic credit for participation Leaders include ISU faculty, staff, students and members of the Ames community. A brochure with current information is published each semester prior to preclassification and can be obtained from the Special Programs office in Osborn Cottage.

Inter-institutional Programs

Students have the opportunity to complete two years of study at another institution and the last two years at Iowa State through coordinated programs offered by the College of Home Economics.

Dual-Degree Programs

Students who complete the first three years in certain curricula at Iowa State and who satisfactorily complete the first year in a recognized medical, dental, veterinary medical, or law curriculum may then be awarded the baccalaureate degree from Iowa State. (See Index, *Preprofessional programs*.)

Iowa Lakeside Laboratory

The Iowa Lakeside Laboratory at Lake Okoboji is a cooperative program in teaching and research in the biological sciences, sponsored jointly by Iowa State University, the University of Iowa, and the University of Northern Iowa. The Laboratory offers course work during two terms of five weeks each in June, July, and August.

Gulf Coast Research Laboratory

Through its affiliation with the Gulf Coast Research Laboratory at Ocean Springs, Mississippi, Iowa State offers its students the opportunity to enroll in courses or to do research in a marine environment by enrolling at Iowa State and paying Iowa State tuition. Courses available to Iowa State students during the two summer terms at the laboratory are listed under the course descriptions of the departments of Botany, Microbiology, and Zoology.

Summer Study Abroad Language Programs

The Regent universities of the State of Iowa cooperate each summer in European study programs of French, German, and Spanish language. These programs of about eight-weeks duration are located in France, Austria, and Spain They offer the student an opportunity to earn 8-12 credits toward graduation, and to participate in an extraordinarily rich cultural experience. The minimum requirement for enrollment in the programs is two years of university-level study of the appropriate language. Further information about requirements and specific courses offered can be obtained from the Department of Foreign Languages and Literatures.

Study Abroad

A number of Iowa State programs offer students the opportunity to study in foreign countries. Although the primary objectives of the specific programs may vary, all provide sound cultural and academic experiences. In some instances the emphasis will be on language study, and in others it will be on other specific disciplines Most programs entail group studies, but individual students may arrange special summer programs involving independent study.

Arrangements for foreign study abroad should be made at an early date. If university credit is desired from study at a foreign institution, the Admissions Office should be contacted well in advance to confirm that credit will be approved here. The Office of International Educational Services coordinates many of these activities and is available to advise interested persons.

Arrangements for foreign study can also be made through the SPAN program and the International Studies option (see Index).

Military Training

Iowa State students may elect to participate in one of the Reserve Officers Training Programs (ROTC) offered at Iowa State by the Army, the Navy, and the Air Force. Descriptions of the specific programs are found under the departments of Air Force Aerospace Studies, Military Science, and Naval Science. A student who completes a four-year program in any of these fields may be commissioned as a military officer at the time of graduation.

Late Afternoon, Evening, and Saturday Classes

In order to make on-campus courses available to those who live within commuting distance of Ames, classes are scheduled in the late afternoon and evening so that persons with full-time employment or other responsibilities may commute and continue their education. As many as 25 departments have offered courses in this manner, and the university publishes a brochure announcing these courses each semester. This publication may be obtained by writing or calling the Office of Admissions and Records, 109 Beardshear Hall, Iowa State University, Ames, Iowa 50011 Information regarding any of these programs may also be obtained by contacting the Office of Admissions and Records.

Off-Campus Credit Courses and Programs

As a land-grant institution Iowa State has shared the conviction that, regardless of location, as many Iowans as possible should have access to the ideas and knowledge available to on-campus students. A number of credit courses and programs are available which present educational opportunities at off-campus locations or via non-traditional delivery means.

The courses are the same as those offered on campus and are taught by regular faculty members. Since the courses are considered resident courses, credit earned in them becomes a part of the student's academic record at Iowa State and may be used to meet degree requirements in the same manner as course credit earned on campus.

Each college of the University endeavors to identify the needs of Iowans and to provide suitable credit courses and programs to meet these needs. Some courses or programs are not suitable for off-campus delivery due to the non-availability of certain learning resources such as libraries or laboratories, or due to non-availability of faculty

Persons interested in currently available courses and their locations, or requesting courses and programs in specific subject matter and locations, should contact the Office of Continuing Education, Iowa State University, or one of the twelve ISU Area Extension offices located in Cedar Rapids, Council Bluffs, Creston, Davenport, Des Moines, Dubuque, Fort Dodge, Mason City, Ottumwa, Sioux City, Spencer and Waterloo.

Many off-campus credit courses are offered because of a special interest or need by a particular group and are not, therefore, part of any special program. However, in some locations a series of courses may be offered to fulfill certain academic or educational objectives. Some of the programs offered are listed below:

Master of Agriculture

The major in professional agriculture is an off-campus program leading to the degree Master of Agriculture. It is available to students who wish to pursue graduate study in agriculture with a minimum of course work on campus. The program is considered to be a terminal master's degree. Those who major in professional agriculture are required to take a minimum of two courses in each of three disciplines and complete 24 semester credits of formal course work. Courses are offered in Agricultural Mechanization, Agronomy, Animal Science and Economics.

A minimum of four credits of creative component experience is required. A thesis option is not available. The creative component is a demonstration of independent creativity with a written report of laboratory, field or library research acceptable to the student's program-of-study committee. Four workshops of one credit each are required. The workshop in

applied statistics is mandatory. Two of the workshops must be taken on campus.

The program-of-study committee in consultation with the student will determine the courses to be taken and the acceptability of transfer credits and on-campus course work. The major professor should be selected from the discipline where a concentration of course work will be taken.

Students who wish to pursue this off-campus major must meet the same admission requirements as other students seeking admission to graduate study.

Masters Programs in Education

The College of Education endeavors to identify needs of educators across the state and provide suitable courses and programs to satisfy these needs. Masters degree programs in counselor education; educational administration; industrial education; adult education; higher education; and historical, philosophical, and comparative studies in education are or may be offered in various parts of the state.

Masters Programs in Engineering

The academic standards and the general level of attainment are the same for the Master of Engineering and Master of Science degrees. Master of Engineering programs are offered to meet the needs for professionally-oriented programs at locations with adequate library and laboratory facilities.

An appropriate number of credit hours in design, laboratory work, computation and independent study is required as evidence of individual accomplishment.

Of the minimum credit requirement of 30 semester credits, 22 credits must be received from Iowa State University.

Masters Program in Home Economics

The College of Home Economics provides a variety of courses to meet the needs of students who are pursuing a masters degree, who want general updating in the field, or who want courses for certificate renewal. The degree is in home economics education and includes work in that department, in other departments in the College of Home Economics, and in other colleges. Specific course requirements will depend upon the field of work the student expects to pursue. Courses are offered in late afternoon or evening to allow persons with full-time occupations to attend classes.

Master of Public Administration

The Department of Political Science offers a Master of Public Administration degree designed to meet the needs of full-time students as well as mid-career employees in public service. The design of the program rests on the belief that policy formulation and administration of government require special training because of the changing demands and technology of society.

The Public Administration program has two basic goals. It attempts to provide education that will: (1) increase the understanding of individuals of the political system of local, state and national governments; and (2) improve competence on the job.

To accomplish these goals the program blends innovative and flexible teaching methods with well-formulated guidelines. With the cooperation of other departments in the University the program offers a multi-disciplinary approach covering a variety of subjects including analytical tools, policy analysis, organizational dynamics and management, and the political-social-economic basis of public service.

Course work is offered in late afternoons and evenings or at specially arranged times to allow individuals with full-time occupations to attend classes. Generally, the degree takes two years to complete, depending upon the time and abilities of the students.

Bachelor of Liberal Studies

Through the College of Sciences and Humanities, the University offers the Bachelor of Liberal Studies (BLS) degree to students whose personal commitments prevent full-time, on-campus study. The BLS degree is offered with similar requirements by all three Regent universities, and provides a framework for off-campus students to assemble all of the educational opportunities they may have locally available into a coherent four-year educational program. The Regent universities and other four-year colleges support the third and fourth years of study; formal admission to the BLS program is granted only after students have completed an Associate in Arts or Associate in Science degree from an accredited two-year college or have completed at least 62 semester credits acceptable toward graduation at the chosen Regent university with a grade-point average of at least 2.00. Inquiries concerning the program at Iowa State should be directed to the Associate Dean for Academic Programs of the College of Sciences and Humanities.

Television and Radio Courses Program

Broadcast radio or television lessons offer college credit to persons all over Iowa through this home study program. In addition to the radio or television segments each course contains textbooks, written assignments, exams, and a study guide packet. Instructor contact is handled by phone or mail. Exams are taken at one of the 19 Learning Centers throughout the state. Courses change from term to term with approximately half of the offerings coming from the liberal arts area and the remainder from professional studies. Television and radio segments are developed by a variety of institutions in the U.S, with Iowa State University adapting and supplementing each course to meet its university requirements. These courses are considered to be resident Iowa State University courses and may be used to meet degree requirements in the same manner as courses taken on campus.

Admission

Undergraduate and Special Students. A high school graduate may enroll in off-campus undergraduate courses as a special student. However, after the accumulation of a number of college credits, a formal application for admission as a regular undergraduate student should be accomplished and an adviser obtained. (See *Admission of New Undergraduate Students*.)

Graduate Students. A graduate of a regionally accredited college or university in the United States, if admitted to the Graduate College, may enroll occasionally in off-campus graduate courses as a nondegree graduate student. However, only 9 semester hours of graduate credit earned under the nondegree option may be applied if the student later chooses to enter a degree program. Transfer from nondegree status to full graduate admission requires the procedures specified by the Graduate College. (See *Graduate College Admissions*.)

Enrollment

Enrollment in off-campus courses can be accomplished by contacting any of the area extension offices, the Office of Continuing Education at Iowa State University, or the State Board of Regents Center in Atlantic, in one of three ways: by phone, in person, or by mail.

Advance enrollment is strongly encouraged and enhances the probability of a given course being offered. Registration dates for each semester are announced in published schedules.

Off-Campus Fees. Students taking off-campus courses pay fees as stated in the Hourly Fee Schedule, except for certain cases. For both the Hourly Fee Schedule and exceptions see page 11

Withdrawal and Refund. A student who wishes to withdraw from a course must first notify the instructor, and then the Office of Continuing Education (in writing), 102 Scheman, Iowa State University, Ames, Iowa 50011. A 100 percent refund will be made if a student withdraws by the end of the second class period No refund will be made for withdrawal after the second class period.

Minimum Enrollment. A minimum enrollment is required to permit the offering of an off-campus class.

Services

Activity Fee. Off-campus students may pay an activity fee in addition to course fees, each semester, which qualifies them and their spouses for student admission rates to concerts, lectures, and athletic events. Students wanting to pay the activity fee should so indicate at registration.

Library. Off-campus students in good standing (fees paid) may use the ISU Library by simply identifying themselves. The Library has access to records of all students enrolled.

Identification Cards. These may be provided to fully admitted students upon request to the Office of the Registrar.

Student Counseling Service. Services are available to off-campus students at the Student Counseling Service.

Veteran Benefits. The Office of the Registrar will provide advice as to proper procedure for application and certification for veteran's benefits.

Academic Regulations

The academic regulations of the University are published annually in the ISU Information Handbook. Each student is provided with a copy of the handbook at initial registration and is expected to know and to follow the policies and procedures outlined therein

Grading System

Grades are reported on a 4 00 scale, with quality points per credit hour assigned as follows:

A	4 points	D	1 point
B	3 points	F	0 points
C	2 points		

The student's quality-point average, based on the quality points obtained for each course divided by the total number of credits for which the student has registered, is calculated for each semester as well as on a cumulative basis This information is included in the grade report supplied to the student at the end of each semester

A few courses are graded on a satisfactory-fail basis only; a grade of S (satisfactory) carries credit toward graduation but is not included in calculation of the quality-point average

Students who have completed 45 credits may elect to enroll in a limited number of courses under a Pass-Not Pass option, in which a grade of D or better is recorded as Pass (P) and a grade of F is recorded as Not Pass (NP). Neither P nor NP are included in calculation of the quality-point average, but a grade of Pass provides credit toward graduation The Information Handbook contains the specific regulations governing the use of this option

A student may elect to repeat a limited number of credits for which only the credit most recently earned will be included in calculation of the student's quality-point average This privilege provides an opportunity for a student to overcome the effects of a poor academic term

Satisfactory Academic Progress

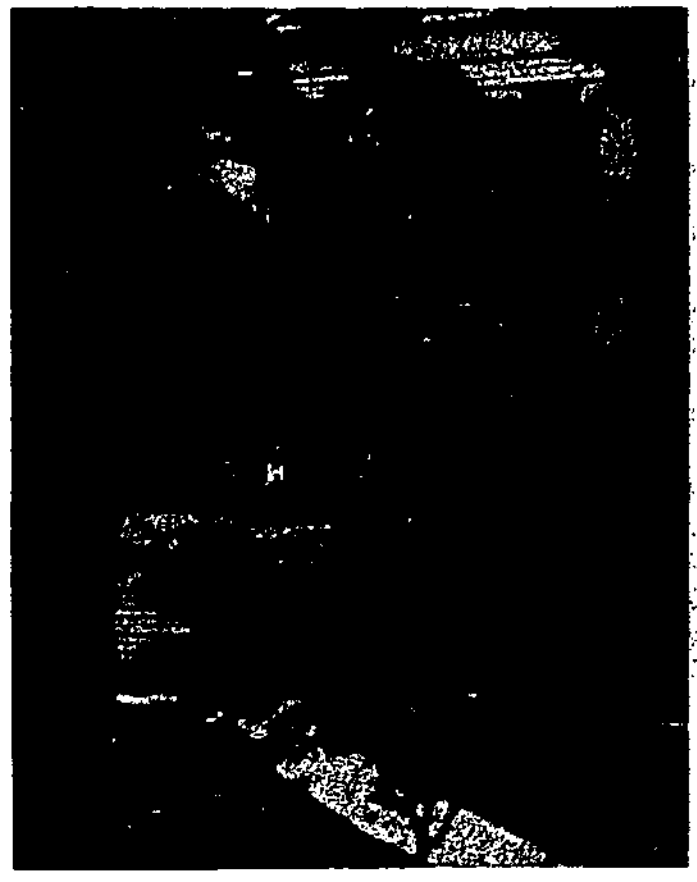
Minimum satisfactory scholastic achievement is represented by a 2.00 quality-point average each semester of enrollment. Students who fall below this level may be placed on temporary enrollment for a semester, if they fail to meet the required standard of performance, they may then be dismissed from the University. Decisions concerning placement on temporary enrollment and dismissal are made by the college academic standards committees in accordance with guidelines established by the University Academic Standards Committee

Class Attendance

Students are expected to attend class meetings as scheduled. Each instructor sets his or her own policy with respect to class attendance, and excuses for absence from class are handled between the student and the instructor.

Designators

Acct	Accounting
A E	Agricultural Engineering
A Ecl	Animal Ecology
Ad Ed	Adult and Extension Education
Aer E	Aerospace Engineering
AFAS	Air Force Aerospace Studies
Ag Ed	Agricultural Education
Ag M	Agricultural Mechanization
Ag St	Agricultural Studies
Agron	Agronomy
Am In	American Indian Studies
An S	Animal Science
Anthr	Anthropology
Arch	Architecture
Art	Art and Design
Astro	Astronomy and Astrophysics
Ath	Athletics
B B	Biochemistry and Biophysics
B M E	Biomedical Engineering
Biol	Biology
Bot	Botany
BusAd	Business Administration
C D	Child Development
C E	Civil Engineering
C Grk	Classical Greek
Ch E	Chemical Engineering
Chem	Chemistry
Cl St	Classical Studies
Co Ed	Counselor Education
Com S	Computer Science
Con E	Construction Engineering
Cpr E	Computer Engineering
C R P	Community and Regional Planning
Curr	Curriculum and Instructional Media
Dance	Dance
Dsn S	Design Studies
E E	Electrical Engineering
E M	Engineering Mechanics
E Op	Engineering Operations
E Sci	Engineering Science
Ea Sc	Earth Science
Econ	Economics
EdAdm	Educational Administration
El Ed	Elementary Education
Engl	English
Ent	Entomology
Env S	Environmental Studies
F E	Family Environment
Fin	Finance
F Lng	Foreign Languages and Literatures
F N	Food and Nutrition
F Tch	Food Technology
For	Forestry
Fr E	Freshman Engineering
Frnch	French
GP S	Geodesy, Photogrammetry, and Surveying
Gen	Genetics
Geog	Geography
Geol	Geology
Ger	German
Gr St	General Graduate Studies
H Ed	Home Economics Education
HE St	Home Economics Studies
H P C	Historical, Philosophical, and Comparative Studies in Education
H S	Health Studies
Hg Ed	Higher Education
Hist	History
Hort	Horticulture
Hous	Housing
I A S	Industrial Administrative Sciences
I E	Industrial Engineering
I Ed	Industrial Education
I Mgt	Institution Management
I R	Industrial Relations
Imbio	Immunobiology
Ital	Italian
IVTE	Industrial Vocational Technical Education
Jl MC	Journalism and Mass Communication
L A	Landscape Architecture
L S	Leisure Studies
Latin	Latin
Lib	Library
M E	Mechanical Engineering
M S	Military Science
M S E	Materials Science and Engineering
Math	Mathematics
MCDB	Molecular, Cellular and Developmental Biology
Mgmt	Management
Micro	Microbiology
Mkt	Marketing
Mteor	Meteorology
Music	Music
N S	Naval Science
Nuc E	Nuclear Engineering
P E	Physical Education
P M	Pest Management
Phil	Philosophy
Phys	Physics
Pol S	Political Science
Port	Portuguese
PP SW	Plant Pathology, Seed and Weed Sciences
ProAg	Professional Agriculture
Pr St	Professional Studies in Education
Psych	Psychology
Relig	Religious Studies
ResEv	Research and Evaluation
Rus	Russian
SafEd	Safety and Driver Education
S-H	Sciences and Humanities
SecEd	Secondary Education
Soc	Sociology
Sp	Speech
Span	Spanish
Stat	Statistics
T C	Textiles and Clothing
TrLog	Transportation/Logistics
Tr Pl	Transportation Planning
T SC	Technology and Social Change
U St	University Studies
V An	Veterinary Anatomy
V C S	Veterinary Clinical Sciences
V Med	Veterinary Medicine
V MPM	Veterinary Microbiology and Preventive Medicine
V P P	Veterinary Physiology and Pharmacology
V Pth	Veterinary Pathology
W Res	Water Resources
W S	Women's Studies
Zool	Zoology



applied statistics is mandatory. Two of the workshops must be taken on campus.

The program-of-study committee in consultation with the student will determine the courses to be taken and the acceptability of transfer credits and on-campus course work. The major professor should be selected from the discipline where a concentration of course work will be taken.

Students who wish to pursue this off-campus major must meet the same admission requirements as other students seeking admission to graduate study.

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A student may elect to repeat a limited number of credits for which only the credit most recently earned will be included in calculation of the student's quality-point average. This privilege provides an opportunity for a student to overcome the effects of a poor academic term

Satisfactory Academic Progress

Minimum satisfactory scholastic achievement is represented by a 2.00 quality-point average each semester of enrollment. Students who fall below this level may be placed on temporary enrollment for a semester; if they fail to meet the required standard of performance, they may then be dismissed from the University. Decisions concerning placement on temporary enrollment and dismissal are made by the college academic standards committees in accordance with guidelines established by the University Academic Standards Committee

Class Attendance

Students are expected to attend class meetings as scheduled. Each instructor sets his or her own policy with respect to class attendance, and excuses for absence from class are handled between the student and the instructor.

Designators

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A Ecl	Animal Ecology
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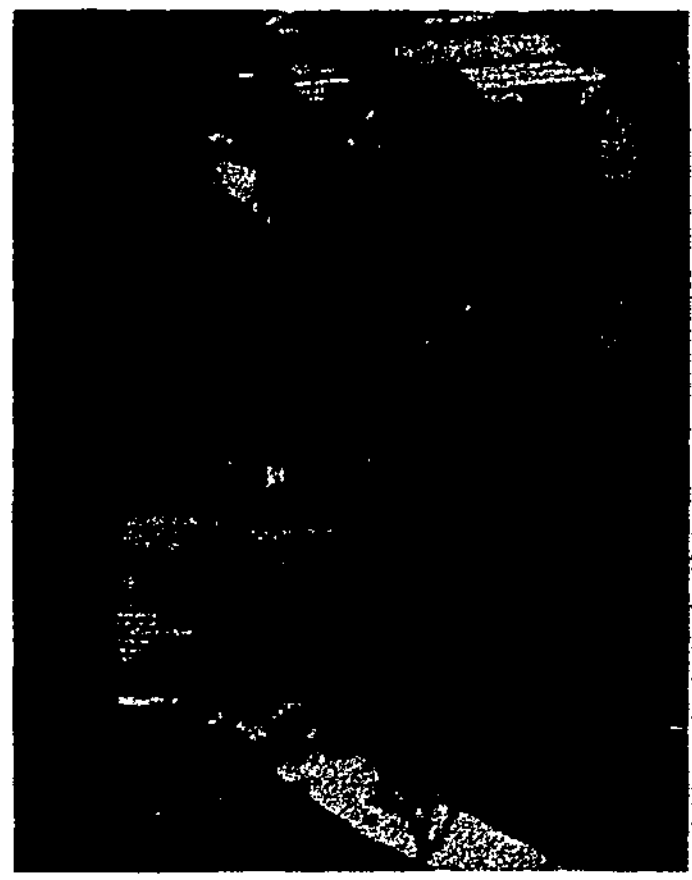
AFAS	Air Force Aerospace Studies
Ag Ed	Agricultural Education
Ag M	Agricultural Mechanization
Ag St	Agricultural Studies
Agron	Agronomy
Am In	American Indian Studies
An S	Animal Science
Anthr	Anthropology
Arch	Architecture
Art	Art and Design
Astro	Astronomy and Astrophysics
Ath	Athletics
B B	Biochemistry and Biophysics
B M E	Biomedical Engineering
Biol	Biology
Bot	Botany
BusAd	Business Administration
C D	Child Development
C E	Civil Engineering
C Grk	Classical Greek
Ch E	Chemical Engineering
Chem	Chemistry
Cl St	Classical Studies
Co Ed	Counselor Education
Com S	Computer Science
Con E	Construction Engineering
Cpr E	Computer Engineering
C R P	Community and Regional Planning
Curr	Curriculum and Instructional Media
Dance	Dance
Dsn S	Design Studies
E E	Electrical Engineering
E M	Engineering Mechanics
E Op	Engineering Operations
E Sci	Engineering Science
Ea Sc	Earth Science
Econ	Economics
EdAdm	Educational Administration
El Ed	Elementary Education
Engl	English
Ent	Entomology
Env S	Environmental Studies
F E	Family Environment
Fin	Finance
F Lng	Foreign Languages and Literatures
F N	Food and Nutrition
F Tch	Food Technology
For	Forestry
Fr E	Freshman Engineering
Fmch	French
GP S	Geodesy, Photogrammetry, and Surveying
Gen	Genetics
Geog	Geography
Geol	Geology
Ger	German
Gr St	General Graduate Studies
H Ed	Home Economics Education
HE St	Home Economics Studies
H P C	Historical, Philosophical, and Comparative Studies in Education
H S	Health Studies
Hg Ed	Higher Education
Hist	History
Hort	Horticulture
Hous	Housing
I A S	Industrial Administrative Sciences
I E	Industrial Engineering
I Ed	Industrial Education
I Mgt	Institution Management
I R	Industrial Relations
Imbio	Immunobiology
Ital	Italian
IVTE	Industrial Vocational Technical Education
Jl MC	Journalism and Mass Communication
L A	Landscape Architecture
L S	Leisure Studies
Latin	Latin
Lib	Library
M E	Mechanical Engineering
M S	Military Science
M S E	Materials Science and Engineering
Math	Mathematics
MCDB	Molecular, Cellular and Developmental Biology
Mgmt	Management
Micro	Microbiology
Mkt	Marketing
Mteor	Meteorology
Music	Music
N S	Naval Science
Nuc E	Nuclear Engineering
P E	Physical Education
P M	Pest Management
Phil	Philosophy
Phys	Physics
Pol S	Political Science
Port	Portuguese
PP SW	Plant Pathology, Seed and Weed Sciences
ProAg	Professional Agriculture
Pr St	Professional Studies in Education
Psych	Psychology
Relig	Religious Studies
ResEv	Research and Evaluation
Rus	Russian
SafEd	Safety and Driver Education
S-H	Sciences and Humanities
SecEd	Secondary Education
Soc	Sociology
Sp	Speech
Span	Spanish
Stat	Statistics
T C	Textiles and Clothing
TrLog	Transportation/Logistics
Tr Pl	Transportation Planning
T SC	Technology and Social Change
U St	University Studies
V An	Veterinary Anatomy
V C S	Veterinary Clinical Sciences
V Med	Veterinary Medicine
V MPM	Veterinary Microbiology and Preventive Medicine
V P P	Veterinary Physiology and Pharmacology
V Pth	Veterinary Pathology
W Res	Water Resources
W S	Women's Studies
Zool	Zoology



College of Agriculture

Lee Kolmer, Dean
Louis M. Thompson, Associate Dean

Departments of the College

Agricultural Education
Agricultural Economics
Agricultural Engineering
Agricultural Studies
Agronomy
Animal Ecology
Animal Science
Biochemistry and Biophysics
Entomology
Food Technology
Forestry
Genetics
Horticulture
Journalism and Mass Communication
Plant Pathology, Seed and Weed Sciences
Sociology

Students enrolled in the College of Agriculture are provided a broad-based education which includes course work in communications; biological, physical, and social sciences; humanities; and technical subject matter.

Upon graduation students find diverse career opportunities, because of the well balanced education they have received as an undergraduate in their chosen curricula in the College of Agriculture. Opportunities for graduates include production agriculture, business and industry, public agencies, education, and graduate studies.

Curricula in Agriculture

A student has a variety of curricula from which to choose. Each curriculum is unique yet there are many courses common to all curricula. This is helpful to students in that they may transfer from one curriculum to another in the College of Agriculture before the second year with little, if any, loss of credits. The major difference found among curricula is in the course work required by the department. In some departments, specialization options further define the curricula and required course work. In all cases, curricula are designed to assist the student in preparation for his or her chosen profession. Curricula in agriculture are:

Primary Majors
Agricultural Biochemistry
Agricultural Business
Agricultural Education
Agricultural Journalism
Agricultural Mechanization
Agronomy
Animal Ecology
Animal Science
Biometry
Dairy Science
Entomology
Farm Operation
Fisheries and Wildlife Biology
Food Technology
Forestry
Horticulture
Plant Pathology
Public Service and Administration in Agriculture

Secondary Majors
Agricultural Extension Education
International Agriculture
International Studies
Pest Management
Seed Science

A secondary major must be taken in conjunction with a primary major.

Special Nondegree Programs
General Agriculture
Farm Operation (2-year program)
Farm Operation (winter program)
Preveterinary Medicine

Program Development

Students may use their electives to broaden their education, or to strengthen an area of specialization. Electives may be used to meet the requirements for a double major. Those who wish to change their curriculum, or who decide to graduate with a double major, must be enrolled for the last two semesters in the curriculum in which they expect to graduate. Students who enroll in ROTC may apply these credits toward elective requirements.

A student may wish to prepare for admission to a professional program such as law, medicine, or veterinary medicine while pursuing a program toward a Bachelor of Science degree in the College of Agriculture. This may be accomplished through several curricula; however, it is recommended that the student work closely with an academic adviser

Each department prepares a curriculum guide which is available to students to assist them in charting their long-term programs and to specify the exact requirements for graduation. Some curricula require that students declare one or more minors. Students must declare minors when required, through the academic advisers prior to being classified as seniors. Students declaring minors must include at least 15 credits for each minor.

Preparation for Study in the College of Agriculture

Recommended minimum preparation for study in the College of Agriculture should include the following high school training.

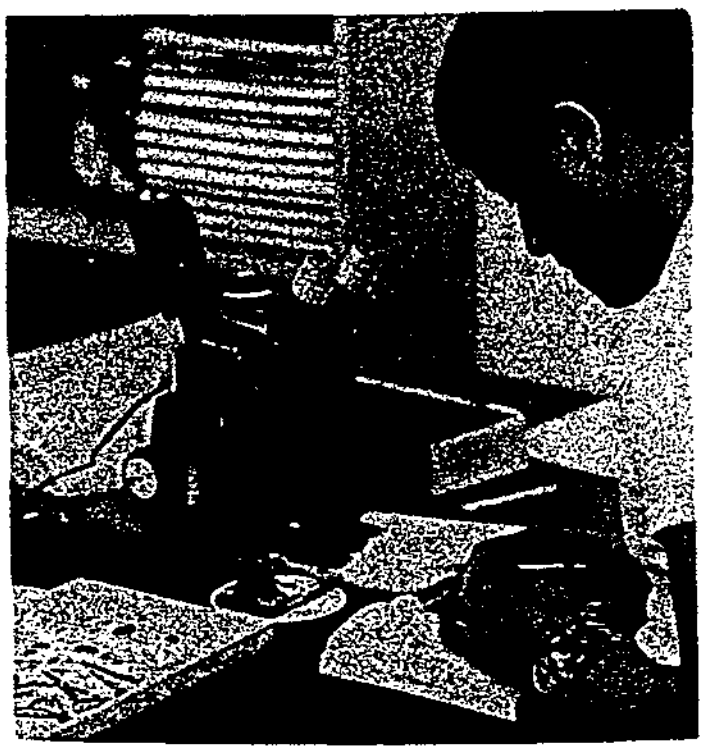
1. Three years of English-speech with emphasis in composition and communication skills.
2. Mathematics through intermediate algebra.
3. Strong emphasis in biology and the physical sciences, especially chemistry, is desirable for most curricula

Students with deficiencies in the above areas may be required to take courses that will not count toward graduation requirements

Core Curriculum

With the exception of the winter program and 2-year certificate program in farm operation, all curricula in the College of Agriculture lead to a Bachelor of Science degree. Each curriculum, has specific degree requirements for graduation, which include the group requirements for the College of Agriculture core curriculum.

Cr.	Group Requirements
9	I. Communications (Selected courses in English, journalism, and speech that improve written or spoken communication skills, plus library.)
13	II. Mathematical and physical sciences (Courses covering topics in biochemistry, chemistry, computer science, geology, mathematics, meteorology, physics, and statistics that strengthen the student's scientific background.)
6	III. Biological sciences (Selected courses in animal ecology, biochemistry, biology, botany, entomology, genetics, microbiology, and zoology that provide a basic understanding of plants and animals)
6	IV. Social sciences (Selected courses covering topics in economics, political science, psychology, and sociology that provide an understanding in human behavior.)
6	V. Humanities (Courses selected from art, history, literature, music, or philosophy to increase cultural awareness.)



Advising System

Each student in the College of Agriculture works closely with an academic adviser who is associated with the curriculum in which the student is majoring. All entering students and their parents are encouraged to participate in the summer orientation program in which they will have the opportunity to meet and work with academic advisers in planning their first semester schedule of classes. The advisers also assist students in making personal adjustments to university life, and provide helpful information on vocational choices A special effort is made by the advisers in the College of Agriculture to adjust the schedule of course work in accordance with students' interests and capabilities

Graduate Study

Graduate study in agriculture is conducted through the Graduate College Details are found in the *Graduate College* section of this catalog

Various departments in the College of Agriculture also participate in the following graduate-level interdepartmental offerings.
Immunobiology
Molecular, Cellular and Developmental Biology
Professional Agriculture
Technology and Social Change (interdepartmental minor)
Water Resources (interdepartmental major)

For details, consult the *Graduate College* section of this catalog

Program in Preveterinary Medicine

One may enroll as a preveterinary medicine student in the College of Agriculture until the primary major is selected for a degree program The student is encouraged to select a primary major as soon as possible Once the primary major is selected the student's adviser will be in the primary major department

The preveterinary medicine program may be completed along with any curriculum in the College of Agriculture, but the time required will depend on the curriculum selected

For requirements for admission to the College of Veterinary Medicine see page 67

Program in General Agriculture

General agriculture is a nondegree program for undeclared majors in the College of Agriculture

Curriculum in Agricultural Biochemistry

Administered by the Department of Biochemistry and Biophysics

Cr.	Degree Requirements
9.5	**Communications** Engl 104, 105; Lib 160; Sp 211 or Engl 414
11-12	**Mathematical sciences** Math 165, 166, Stat 101 or 104
37	**Physical sciences** Chem 177, 177L, 178, 211, 321, 321L, 322, 331, 332, 333A, Phys 221, 222
13-15	**Biological sciences** Biol 110, 110L, 312; Zool 206 and 206L or Bot 207, Gen 330 or 320
6	**Social sciences**
6	**Humanities**
9	**Agricultural sciences** Complete three of the following four options: Agron 114 or Hort 221, Agron 154; AnS 114, F Tech 101
13-15	**Agricultural Biochemistry** BB 101, 102, 201, 404, 405 (or 501, 502), 411 Students wishing research experience in agricultural biochemistry are encouraged to enroll in BB 499
10	**Supportive electives***
8.5-13.5	**Electives**
128	**Total Credits**

*These courses, to be selected from an approved list available in the departmental office, shall include two related courses in agricultural science.

Typical Program for the First Year

Cr.	Fall
4	General Chemistry — Chem 177
1	Laboratory in General Chemistry — Chem 177L
4	Calculus I — Math 165
3	Freshman Composition — Engl 104
3	Principles of Biology — Biol 110
1	Introduction to Biochemical Activities — BB 101
	Spring
3	General Chemistry — Chem 178
4	Quantitative Analysis — Chem 211
4	Calculus II — Math 166
3	Freshman Composition — Engl 105
1	Laboratory in General Biology — Biol 110L
1	Introduction to Biochemistry — BB 102

Curriculum in Agricultural Business

Administered by the Department of Economics. Students are required to select one area of specialization from the following: economic analysis, public policy, farm management, agribusiness management, agricultural finance, agricultural sales and marketing.

Cr.	Degree Requirements
12.5	**Communications** Engl 104, 105, 414; Sp 211; Lib 160
13	**Mathematical sciences** Math 150, 151; Stat 227, 228
5	**Physical sciences** Chem 163, 163L
6	**Biological sciences** Biol 109; electives (3 cr.)*
17	**Social sciences** Econ 201, 401, 402; electives other than Econ and BusAd 6
6	**Humanities**
27-28	**Agricultural economics and business** Econ 110, 192, 330, 335, 447, 451 or Mgmt 315; Acct 284, 285; Fin 350
12	**Agricultural sciences** Agron 114, 154; An S 114, 218*
15-16	**Required area of specialization**
12.5-14.5	**Free electives***
128	**Total Credits**

*Agricultural business students choosing to pursue advanced-level courses in animal science are encouraged to include BB 221, Gen 320, and VPP 229 among their biological science electives, and to substitute An S 318 and 319 for An S 218. Students wishing to take advanced-level courses in agronomy are encouraged to include Gen 320 as a biological science elective and Chem 231 and 232A among free electives.

Typical Program for the First Year

Cr.	Fall
R	Orientation in Agricultural Business — Econ 110
4	Agribusiness Operations — Econ 192
3	Principles of Crop Production — Agron 114
3	Mathematics for Business and Social Sciences I — Math 150
3	Freshman Composition — Engl 104
3	Introductory Biology — Biol 109
	Spring
5	General Chemistry — Chem 163, 163L
3	Survey of the Animal Industry — An S 114
3	Mathematics for Business and Social Sciences II — Math 151
3	Freshman Composition — Engl 105
3	Social science elective

Preprofessional Studies

Agricultural business provides preparation for studies in law.

Curriculum in Agricultural Education

Students in agricultural education may pursue a diversified or specialized program to prepare for teaching vocational agriculture. For certification in an area of agricultural specialization, a total of 48 agriculture credits is required, with at least 20 credits in one area, 10 credits in a second area, and 18 credits in remaining required agriculture courses and agriculture electives.

Described below is the diversified approach to certification for teaching vocational agriculture.

Cr.	Degree Requirements
9.5	**Communications** Engl 104, 105; Lib 160; Sp 211
13	**Mathematical and physical sciences** Chem 163, 163L; BB 221; mathematics or statistics electives (3 cr.); electives (2 cr.)
6	**Biological sciences** Biol 109; electives (3 cr.)

10	**Social sciences** Psych 230, 333; electives (4 cr.)
6	**Humanities** Electives from approved list
1	**Physical education**
40	**Agricultural sciences** Agron 114, 154, electives (4 cr.); An S 114, 214, electives (4 cr.); Ag M 285, 488, electives (5 cr.); Acct 381, Econ 201, economics electives (4 cr.)
27.5	**Professional credits** Sec Ed 204, 301, 406, 426; Ag Ed 110, 111, 211, 311, 410, 411, 417A
15	**Free electives**
128	**Total credits**

Typical Program for the First Year

Cr.	Fall
3	Freshman Composition — Engl 104
3	Mathematics elective
3	Principles of Crop Production — Agron 114
3	Metal Construction and Maintenance — Ag M 285
R	Orientation in Agricultural Education — Ag Ed 110
0.5	Library Instruction — Lib 160
	Spring
3	Freshman Composition — Engl 105
4	Principles of Economics — Econ 201
3	Survey of the Animal Industry — An S 114
3	Agricultural mechanization elective
0.5	Survey of Vocational Agriculture Programs — Ag Ed 111
3	Foundations of American Education — SecEd 204

Curriculum in Agricultural Extension Education

Administered by the Department of Agricultural Education. Agricultural extension education may be taken only as a secondary major in a double major program. The primary major must be a curriculum in the College of Agriculture

Cr.	Degree Requirements
17.5	**Communications** Engl 104, 105, 302; Jl MC 225; Sp 211, 312; Lib 160
13	**Mathematical and physical sciences** Chem 163, 163L; B B 221; mathematics or statistics electives (3 cr.); electives (2 cr.)
6	**Biological sciences** Biol 109; electives (3 cr.)
12	**Social sciences** Soc 130 or 134, 264, two or more of the following: Soc 310, 382, 415, 464, 473, 485
6	**Humanities** Electives from approved list
20	**Professional courses** Ag Ed 214, 314, 414; Ad Ed 469; electives (5 cr.)
53.5	**Primary major requirements and free electives**
128	**Total credits**

Typical Program for the First Year

Because agricultural extension education is a secondary major that has requirements that are similar in several aspects to those of the agricultural education major, courses taken by the student during the first year will be similar to those taken by first-year agricultural education majors. Differences in individual programs will reflect the student's choice of primary major.

Curriculum in Agricultural Journalism

Administered by the Department of Journalism and Mass Communication.

Cr.	Degree Requirements
12.5	**Communications** Engl 104, 105; Sp 211; Lib 160; elective (3 cr.) of written or spoken English
6	**Mathematical sciences** Mathematics, statistics or computer science
11	**Physical sciences** Select from courses in chemistry, physics, geology, meteorology, or metallurgy. (Course requirements in this area depend on the student's area of concentration in agriculture See your adviser.)
7	**Biological sciences** Biol 109 or 110; elective (4 cr.)
10	**Social sciences** Econ 201; Pol S 215, elective (3 cr.) in one other area of social sciences
9	**Humanities** Hist 365 or 366, elective (6 cr) in art, history, literature, music, or philosophy
24	**Agricultural sciences** Course requirements in this area depend on area of concentration See your adviser for required course list
30-32*	**Journalism and Mass Communication**
10	Jl MC 101, 201, 202, 203
9-10	Jl MC 300-level skills courses (must include one from 345, 352, 360, 361, 370)
6	Jl MC 430, 491, 499
5-6	Jl MC 400-level advanced courses (must include one from 410, 431, 462)
16.5-18.5	**Free electives**
128	**Total credits**

*National journalism accreditation standards recommend that the number of journalism credits in the degree program be limited to approximately one-quarter of total credits taken.

Typical Program for the First Year

Cr.	Fall
3	Freshman Composition — Engl 104
3-4	Mathematics elective
3	Introductory Biology — Biol 109
0.5	Library Instruction — Lib 160
4	Principles of Economics — Econ 201
3	American Government — Pol S 215
	Spring
3	Freshman Composition — Engl 105
3	Physical science elective
3	Principles of Crop Production — Agron 114
2	Introduction to Mass Communication — Jl MC 101
3	Introduction to Sociology — Soc 134
3	Fundamentals of Speech — Sp 211

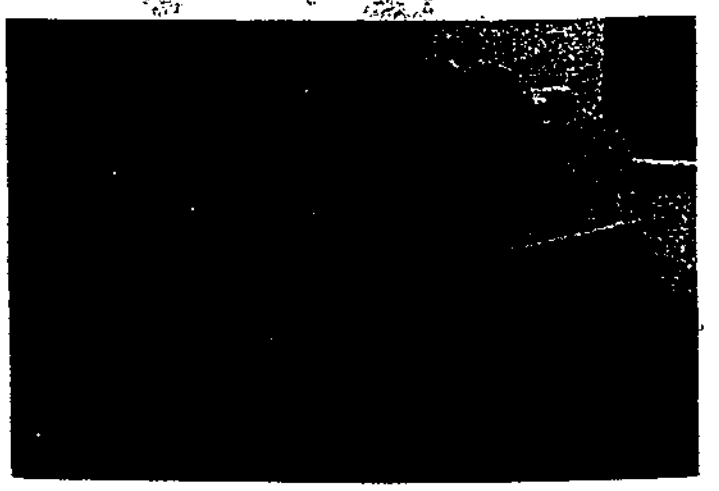
Curriculum in Agricultural Mechanization

Administered by the Department of Agricultural Engineering.

Cr.	Degree Requirements
9.5	**Communications** Engl 104, 105; Sp 211, Lib 160
10-12	**Mathematical sciences** Math 165 or both 140 and 142; Stat 104; Com S 175
12-13	**Physical sciences** Chem 163, 163L; BB 221 or both Chem 231 and 232A; Phys 111
6	**Biological sciences** Biol 109; electives (3 cr.)
7	**Social sciences** Econ 201, Pol S 215
6	**Humanities**
17	**Agricultural sciences** An S 114, 218; Agron 154, 212; Econ 330
32	**Agricultural mechanization** Ag M 110, 191, 250, 285, 324, 326, 330, 335, 360, 362, 435, 473, electives (3 cr.)
12-14	**Other required courses** I Ed 120; Acct 284; Mkt 340 or Econ 335; Mgmt 315 or Econ 451
11.5-16.5	**Electives**
128	**Total credits**

Typical Program for the First Year

Cr.	Fall
2	Principles of Mechanization in Agriculture — Ag M 191
R	Orientation in Agricultural Mechanization — Ag M 110
3	Introductory Biology — Biol 109
3	Freshman Composition — Engl 104
5	General Chemistry — Chem 163, 163L
3	Introduction to Statistics — Stat 104
	Spring
3	Agricultural Construction Materials and Procedures — Ag M 250
3	Freshman Composition — Engl 105
3	Survey of the Animal Industry — An S 114
3	Introduction to Graphic Communications — I Ed 120
3	Fundamentals of Soil Science — Agron 154
0.5	Library Instruction — Lib 160



Curriculum in Agronomy

Students majoring in agronomy study crop science, soil science and agricultural climatology. Areas of specialization may be selected upon consultation with academic advisers

Cr.	Degree Requirements
14.5-15.5	**Communications** Engl 104, 105, Lib 160, Sp 211, select at least two additional courses from Engl 302, 414; Jl MC 225, and Sp 312
6	**Mathematical sciences** Math (3 cr); Stat 104
16	**Physical sciences** Chem 163, 163L, 231, 232A, Geol 100, Phys 106 or 111
15-16	**Biological sciences** Biol 110; Bot 207, 310; select at least two additional courses from Micro 300, Gen 320 and An S 318
6	**Social sciences** Econ 201, one course in Psych or Soc
6	**Humanities***
32	**Agronomic sciences** Ag 104, Agron 110, 114, 154, 206, 311, 318, 354, 411, electives (16 credits of which 8 must be taken at the 400 level No more than 2 credits total from Agron 331X, 371, 400 and 490 will be allowed to meet the 16 credit requirement)
30.5-32.5	**Free electives**
128	Total Credits

*The approved list of courses to satisfy the humanities requirement may be obtained from the agronomy adviser

Typical Program for the First Year

Cr.	Fall
R	Orientation in Agronomy — Agron 110
3	Principles of Crop Production — Agron 114
3	Principles of Biology — Biol 110
3	Freshman Composition — Engl 104
3	Geology and Man — Geol 100
0 5	Library Instruction — Lib 160
3	Mathematics
	Spring
3	Fundamentals of Soil Science — Agron 154
2	Introduction to Meteorology — Agron 206
3	General Botany — Bot 207
4	General Chemistry — Chem 163
1	Laboratory in General Chemistry — Chem 163L
3	Freshman Composition — Engl 105

Curriculum in Animal Ecology

Areas of specialization may be selected upon consultation with academic adviser.

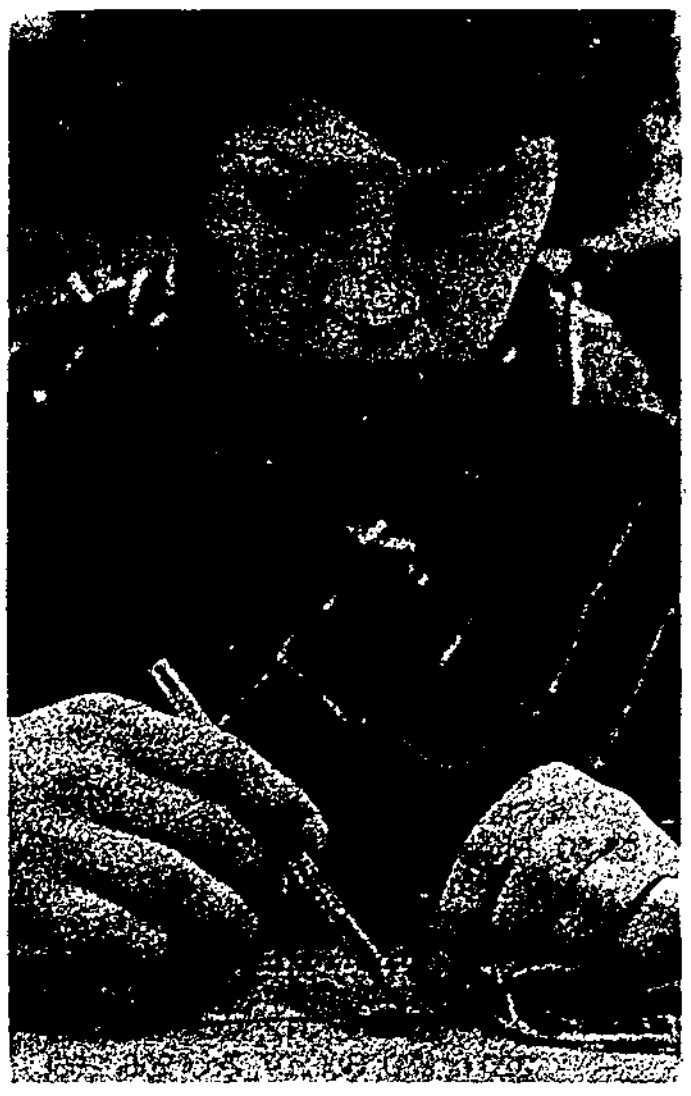
Cr.	Degree Requirements
11.5-12.5	**Communications** Engl 104, 105; Sp 211; Lib 160, one other approved communications course
14-16	**Mathematical sciences** Math 140 and 141, or 142, and 160 or 165, Stat 104, 401
20	**Physical sciences** Chem 163, 163L, 164 (or 177, 177L, 178), 231, 232; Phys 111, 112
5-6	**Meteorology and earth sciences** Agron 206; Agron 154 or Geol 210
36	**Biological sciences** A Ecl 110, 231, 320, 320L, 410, Biol 110, 110L, 303, 312; Bot 207, 484, Gen 320 or 330, Zool 206, 206L, 355 or 459
6	**Humanities**
6	**Social sciences**
15	**Other approved ecologically oriented courses**
R	**Practical experience requirement** (Ag 104)
10.5-14.5	**Free electives**
128	Total Credits

Typical Program for the First Year

Cr.	Fall
4	Principles of Biology — Biol 110, 110L
1	Orientation in Animal Ecology — A Ecl 110
5	General Chemistry — Chem 163, 163L
3	Freshman Composition — Engl 104
3	Fundamentals of Algebra for Science and Higher Mathematics — Math 140
	Spring
2	Wildlife Resource Conservation — A Ecl 231
3	General Chemistry — Chem 164
3	Freshman Composition — Engl 105
2	Trigonometry — Math 141
5	General Zoology — Zool 206, 206L
0 5	Library Instruction — Lib 160

Preveterinary Studies

Preparation for admission to veterinary medicine may be accomplished through the animal ecology curriculum



Curriculum in Animal Science

Cr.	Degree Requirements
12.5	**Communications** Engl 104, 105, 204; Lib 160; Sp 211
6	**Mathematical sciences** Math 150; Stat (3 cr.)
8	**Physical sciences** Chem 177, 177L; BB 221 or organic chemistry (3 cr.)
12	**Biological sciences** Biol 110, 110L; genetics (3 cr.) or microbiology (4 cr.); Zool 155 and 156 or 206 and 206L
10	**Social sciences** Econ 201; electives (6 cr.)
6	**Humanities**
34	**Animal science** An S 110, 114, 210, 214, 318, 319, 331, 352, 360, 370; 9 credits — 3 courses from different commodity areas at the 400 level
6	**Agricultural sciences** Agron 114, 154
33.5	**Free electives**
128	Total credits

Typical Program for the First Year

Cr.	Fall
R	Orientation in Animal Science — An S 110
3	Survey of the Animal Industry — An S 114
3	Principles of Biology — Biol 110
1	Laboratory in General Biology — Biol 110L
3	Freshman Composition — Engl 104
0 5	Library Instruction — Lib 160
3	Mathematics — Math 150
3	Elective
	Spring
3	Principles of Crop Production — Agron 114
4	General Chemistry — Chem 177
1	Laboratory in General Chemistry — Chem 177L
3	Freshman Composition — Engl 105
3	Introduction to Statistics — Stat 104
3	Elective

Preveterinary Studies

Preparation for admission to veterinary medicine may be accomplished through the animal science curriculum.

Curriculum in Biometry

Administered by the Department of Statistics. The major in biometry will take courses in statistics and mathematics, and, with the guidance of an advisory committee from agriculture, will select technical agriculture courses which will provide some depth of training in an agriculturally related area.

Cr.	Degree Requirements
9.5	**Communications** Engl 104, 105; Sp 211; Lib 160
14	**Mathematical sciences** Math 165, 166, 265; Com S 172

12	**Physical sciences** Chem 163, 163L; BB 221; Phys 111
7	**Biological sciences** Biol 110, 110L; Gen 320
6	**Social sciences** Econ 201; electives
6	**Humanities**
9	**Agricultural sciences** An S 114; Agron 114, 154; or approved substitute
21	**Technical agriculture** Selected from agronomy, animal ecology, animal science, biology, entomology, food technology, forestry, or plant pathology as arranged by advisory committee
27	**Statistics** Stat 100, 104, 341, 342, 401, 402, 421, 481, electives
16.5	**Electives**
128	**Total credits**

Typical Program for the First Year

Cr.	Fall
4	Calculus I — Math 165*
3	Freshman Composition — Engl 104
R	Orientation in Statistics — Stat 100
4	Principles of Biology — Biol 110, 110L
4	Principles of Economics — Econ 201
0.5	Library Instruction — Lib 160
	Spring
4	Calculus II — Math 166
3	Freshman Composition — Engl 105
3	Introduction to Statistics — Stat 104
3	Principles of Crop Production — Agron 114
3	Humanities elective

*Math 140 if needed.

Curriculum in Dairy Science

Cr.	Degree Requirements
12.5	**Communications** Engl 104, 105; Sp 211; Lib 160; electives (3)
6	**Mathematical sciences** Stat 104 (3); Math (3 cr.)
8	**Physical sciences** Chem 177, 177L; BB 221 or Chem 331
12-13	**Biological sciences** Biol 110, 110L; Micro 300 (4 cr.) or F Tech 305 (3 cr.); Zool 155 and 156 or Zool 206 and 206L
7	**Social sciences** Econ 201; electives (3 cr.)
6	**Humanities**
34	**Professional dairy science courses** An S 110, 114, 210, 214, 318, 319, 331, 352, 434, 436; Acct 284; electives (6)
6	**Agricultural sciences** Agron 114, 154
35.5-36.5	**Free electives**
128	**Total credits**

Typical Program for the First Year

Cr.	Fall
R	Orientation in Dairy Science — An S 110
3	Survey of the Animal Industry — An S 114
3	Principles of Biology — Biol 110
1	Laboratory in General Biology — Biol 110L
3	Freshman Composition — Engl 104
0.5	Library Instruction — Lib 160
3	Mathematics
3	Elective
	Spring
3	Principles of Crop Production — Agron 114
4	General Chemistry — Chem 177
1	Laboratory in General Chemistry — Chem 177L
3	Freshman Composition — Engl 105
3	Introduction to Statistics — Stat 104
3	Elective

Preveterinary Studies
Preparation for admission to veterinary medicine may be accomplished through the dairy science curriculum.

Curriculum in Entomology

Cr.	Degree Requirements
12.5	**Communications** Engl 104, 105, 414 or 204; Sp 211; Lib 160
6-7	**Mathematical sciences** Math 142; Com S 175 or Math 165 or Stat 104
26-30	**Physical sciences** Chem 177, 177L, 178, 178L, 231 and 232A or 331 and 332 and 333A and 334A; BB 301, 311; Phys 111, 112
25-26	**Biological sciences** Biol 110, 110L, 312; Micro 300; Gen 320 or 330; Bot 207; Zool 206, 206L; Zool 355 or Bot 310
7	**Social sciences** Econ 201; electives
9	**Humanities** electives
6	**Agricultural sciences** Agron 114 or An S 114; Agron 154
16	**Entomology** Ent 110, 370, 376; Ent 490 or P M 491; Ent electives
14.5-20.5	**Free electives**
128	**Total credits**

Typical Program for the First Year

Cr.	Fall
3	Freshman Composition — Engl 104
3	Principles of Biology — Biol 110
1	Laboratory in General Biology — Biol 110L
4	General Chemistry — Chem 177
1	Laboratory in General Chemistry — Chem 177L
3	Principles of Crop Production — Agron 114 or Survey of the Animal Industry — An S 114
R	Technical Lecture — Ent 110
	Spring
3	Freshman Composition — Engl 105
3	General Chemistry — Chem 178
1	Laboratory in General Chemistry — Chem 178L
3	General Zoology — Zool 206
2	General Zoology Laboratory — Zool 206L
0.5	Library Instruction — Lib 160
2-4	Elective

Preveterinary Studies
Preparation for admission to veterinary medicine may be accomplished through the entomology curriculum

Curriculum in Farm Operation

Administered by the College of Agriculture. The curriculum in farm operation includes a four-year program leading to the degree Bachelor of Science, a two-year program leading to a certificate in technical agriculture, and a collegiate-level winter program.

Cr.	Degree Requirements (4-year degree)
12.5	**Communications** Engl 104, 105; Sp 211 or 311; Lib 160; electives (3 cr.)
6	**Mathematical sciences** Math (3 cr.); Stat 101 or 104 (3 cr.)
6	**Physical sciences** Chem 163, 163L; biochemistry or organic chemistry (3 cr.)
9	**Biological sciences** Biol 109 or 110; electives (6 cr.)
7	**Social sciences** Econ 201; electives (3 cr.)
6	**Humanities**
46	**Agricultural sciences** Ag M electives (6 cr.); Agron 114, 154, 212 (10 cr.); An S 114 or 214, 218 or 318, elective 3 cr., (9 cr.)*; Econ 330 and 300-400 level Ag Econ or Ag 450 (7 cr.); credits 300-level or above to be chosen from agricultural

mechanization, agronomy, animal science, and agricultural economics (14 cr.)
4 Other required courses
Ag 110, 499; Acct 284
29.5 Free electives
128 Total credits

*Farm operation students choosing to develop an emphasis in animal production are advised to take An S 319 and 352 and the appropriate prerequisites. Those emphasizing agronomy, economics or agricultural mechanization may elect to take An S 218.

Typical Program for the First Year

Cr.	Fall
R	Orientation in Farm Operation — Ag 110
3	Survey of the Animal Industry — An S 114
3	Agricultural mechanization elective
3	Freshman Composition — Engl 104
3	Social sciences elective
3	Biol 109
	Spring
3	Principles of Crop Production — Agron 114
3	Agricultural mechanization elective
3	Biological science elective
3	Mathematical science elective
3	Freshman Composition — Engl 105
0 5	Library Instruction — Lib 160

Preveterinary Studies

Preparation for admission to veterinary medicine may be accomplished through the farm operation curriculum.

Certificate Requirements (2-year program*)

6.5	Communications Engl 104, Lib 160; electives (3 cr)
2-5	Physical sciences Chem 150 or 163, 163L
3	Biological sciences Biol 109
3	Social-humanistic elective
31	Agricultural sciences Ag M (7 cr.); two of the following courses (235, 260, 273,) Agron 114, 154, 212, 244; An S 114 or 214, 218, 3 cr. An S elective, Econ 130
R	Other required courses Farm Operation Orientation — Ag 110
15.5-18.5	Free electives
64	Total credits

*A 1.85 grade-point average is required to earn the certificate. The last 21 semester hours in the 2-year program must be taken in residence at Iowa State University.

Certificate Requirements: Winter Program**

Cr.	First Winter
1	Freshman Seminar I — Ag 102
2	Agricultural Maintenance Welding — Ag M 154
3	Animal Production — An S 101
2	Crop and Soil Fundamentals — Agron 142
	Second Winter
1	Freshman Seminar II — Ag 103
2	Soil and Crop Management — Agron 144
3	Farm Business Practice — Econ 130
2	Machinery Systems and Power Management — Ag M 134
16	Total credits

**A 1.70 grade-point average is required to earn the certificate.

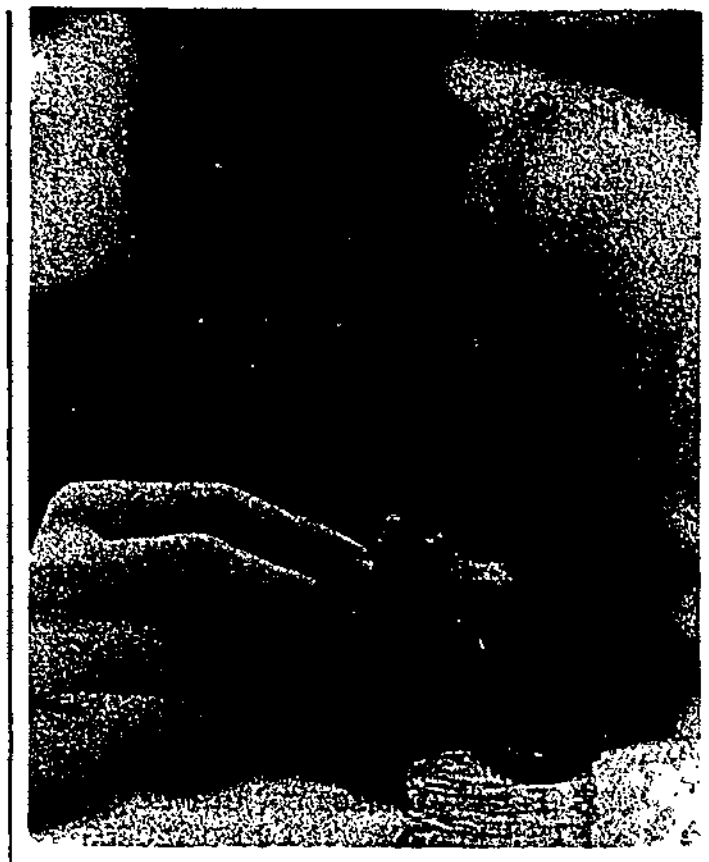
Curriculum in Fisheries and Wildlife Biology

Administered by the Department of Animal Ecology The curriculum provides broad training in both fisheries and wildlife biology. Students may pursue special interests through elective courses and summer employment.

Cr.	Degree Requirements
11.5-12.5	Communications Engl 104, 105; Sp 211; Lib 160; one other approved communications course
9-12	Mathematical sciences Math 140 and 141, or 142; Stat 104, one other approved mathematical sciences course
15-16	Physical sciences Chem 163, 163L, 164; Phys 111 and 112, or Phys 106 and one of the following· Agron 154, Geol 100, Geol 210, or Chem 231 end 232
35	Biological sciences A Ecl 110, 320, 320L, 321, 323, 324, 325, 410; Biol 110, 110L, 312; Bot 207, Zool 206, 206L; one other approved advanced botany course
11	Fisheries and wildlife management A Ecl 231, 350, 440, 441, 451
6	Humanities
7	Social sciences Pol S 215, Econ 201
5-6	Administration, policy, and law Two approved courses
R	Practical experience requirement (Ag 104)
10-14	Restricted electives Selected from list of approved courses
8.5-18.5	Free electives
128	Total credits

Typical Program for the First Year

Cr.	Fall
4	Principles of Biology — Biol 110, 110L
1	Orientation in Animal Ecology — A Ecl 110
5	General Chemistry — Chem 163, 163L
3	Freshman Composition — Engl 104
3	Fundamentals of Algebra for Science and Higher Mathematics — Math 140
	Spring
2	Wildlife Resource Conservation — A Ecl 231
3	General Chemistry — Chem 164
3	Freshman Composition — Engl 105
2	Trigonometry — Math 141
5	General Zoology — Zool 206, 206L
0 5	Library Instruction — Lib 160



Curriculum in Food Technology

Cr.	Degree Requirements
9.5	Communications Engl 104, 105 and 414 or Sp 211; Lib 160
9-10	Mathematical sciences Math 140 or 141, 160; Stat 104
19-26	Physical sciences Chem 177, 177L, 211, 231 or 331 and 332, 232 or 333 and 334, Phys 106 or 111 and 112
11	Biological sciences Biol 110, 110L; Bact 300; BB 301
6	Social sciences Econ 201; elective (2 cr)
6	Humanities
36	Food technology F Tch 101, 102, 110, 301 or 302 or An S 370, 401, 402, 405, 410, 411, 420, 421, 425, 460, 493, 494
5	Food and nutrition F N 107, 304
18.5-26.5	Free electives
128	Total credits

Typical Program for the First Year

Cr.	Fall
3	Freshman Composition — Engl 104
3 or 2	Fundamentals of Algebra — Math 140 or Trigonometry — Math 141
5	General Chemistry — Chem 177, 177L
3	Food and the Consumer — F Tch 101
R	Orientation in Food Technology — F Tch 110
	Spring
3	Freshman Composition — Engl 105
1	Food Quality Evaluation — F Tch 102
4	Principles of Economics — Econ 201
3	Principles of Biology — Biol 110
1	Laboratory in General Biology — Biol 110L
0.5	Library Instruction — Lib 160
3	Humanities elective

Preveterinary Studies

Preparation for admission to veterinary medicine may be accomplished through the food technology curriculum.

Curriculum in Forestry

Students majoring in forestry are required to choose one of the following options: forest products, forest recreation, forest resource management, special programs.

Cr.	Degree Requirements
11.5	**Communications** Lib 160; Engl 104, 105, 414; Sp 212
22	**Mathematical and physical sciences** Math 140, 141, 150, 151; Stat 104; Com S 175; Chem 163, 163L
9	**Biological sciences** Biol 110; Bot 207, 256
7	**Social sciences** Econ 201; Soc 130
6	**Humanities**
33.5	**Forestry courses** For 101, 101L, 110, 201, 202, 203, 204, 241, 301, 360, 380, 380L, 451, 453, 454, Ag 104

Options

28-29	**Forest products** For 397, 481, 485, 486, 487; B B 221 or Phys 111; I E 375; PP SW 416; Soc 382
17-18	**Electives***
29	**Forest recreation** Agron 357; A Ecl 231; Ag M 325; For 302, 344, 414, 470; L A 301, Pol S 371; Soc 382, 383
17	**Electives***
30	**Forest resource management** Agron 357; B B 221; C E 215A, For 302, 342, 397, 445; I E 375; PP SW 416; Soc 382
16	**Electives***
45	**Special programs** Designated courses in approved special program including For 397 and 9 additional credits in forestry courses. See adviser.
135	**Total credits**

*Forestry students are urged to use elective credits to develop a strong minor. See adviser.

Typical Program for First Year

Cr.	Fall
3	Principles of Biology — Biol 110
3	Freshman Composition — Engl 104
2	Introduction to Forestry — For 101
0.5	Orientation in Forestry — For 110
0.5	Library Instruction — Lib 160
3	Fundamentals of Algebra — Math 140
3	Rural Institutions and Organization — Soc 130
15	

Spring

3	General Botany — Bot 207
4	General Chemistry — Chem 163
1	Laboratory in General Chemistry — Chem 163L
3	Applied Computer Programming — Com S 175
3	Freshman Composition — Engl 105
1	Introductory Laboratory in Forestry Practice — For 101L
2	Trigonometry — Math 141
17	

Curriculum in Horticulture

Students majoring in horticulture will select an option in which to specialize prior to reaching junior standing, and will fulfill the requirements described below under *Specialization Options*.

Cr.	Degree Requirements
9.5	**Communications** Engl 104, 105; Lib 160; Sp 211
20-22	**Mathematical and physical sciences** Chem 163, 163L, 164, 164L, 231, 232A; Math 104 or 140 or 150 or 165; Stat 101 or 104 or 227
25-27	**Biological sciences** Biol 109 or 110; Bot 207 and 310 or 320; Ent 376; Gen 320 or 330; PP SW 407; and two courses from the following group: Bot 306, 404, or PP SW 216
10	**Social sciences** Econ 201; Psych 101, electives (3 cr.)
6	**Humanities**
6	**Agricultural sciences** Agron 154, 354.
24-28	**Horticultural sciences** Hort 110, 221, 322, 410, and six courses from the following groups (at least one from each group): **Plant materials:** Hort 232, 241, and 433 **Technical:** Hort 225, 342, and 351 **Food products:** Hort 461, 462, and 471 **Commercial:** Hort 332, 432, and 442
12	**Specialization options** **Production and business management:** Engl 302; Acct 284 and 6 or more credits from the following group: Econ 330, Mgmt 213, 315, 370; Mkt 340, 441, 442, 446, 447 **Communication and public service:** Jl MC 101; Sec Ed 204, 301, and 6 or more credits from the following group: An S 114; Jl MC 201, 202, 225; Psych 230, 333; SecEd 426 **Science:** Math 165; Phys 111 and 4 or more credits from the following group: B B 301, 311; Chem 211, Com S 175; Engl 414; Math 166; Phys 112 **Turfgrass management:** Ag M 358; Acct 284 and 7 or more credits from the following group. Agron 206, 340, 453, 457; Ag M 324, 325, 335, 424; PP SW 238
7.5-15.5	**Electives**
128	**Total credits**

Typical Program for the First Year

Cr.	Fall
3	Principles of Biology — Biol 110
5	General Chemistry — Chem 163, 163L
3	Freshman Composition — Engl 104
R	Orientation in Horticulture — Hort 110
.5	Library Instruction — Lib 160
3	General Psychology — Psych 101

Spring

3	Fundamentals of Soil Science — Agron 154
3	General Botany — Bot 207
4	General Chemistry — Chem 164, 164L
3	Freshman Composition — Engl 105
3	Principles of Horticulture — Hort 221

Curriculum in International Agriculture*

Administered by the International Agricultural Programs Office. International agriculture can be taken only as a secondary major in a double-major program. The primary major must be a curriculum in the College of Agriculture

Cr.	Degree Requirements**
12.5	**Communications** Engl 104, 105; Sp 211, Jl MC 440; Lib 160
13	**Mathematics and physical sciences**
6	**Biological sciences**
19	**Social sciences** Soc 415; Econ 201, 306, 411, Pol S 241 and 422 or 481
7	**Humanities** Anthr 111, 218
8	**Languages** One year of a foreign language or a minimum of six months study abroad in an accredited college program
11	**International courses** U St 241; Agron 406, 415, 483, Ag M 440
51.5	**Primary major requirements and free electives**
128	**Total credits**

*International agriculture is one of two alternative programs for securing a secondary major emphasizing the international dimension. Agricultural students can select the course of study described above or they can choose to follow the alternate program, International Studies in the College of Agriculture. For information on the alternate program, see Index, *International Studies in the College of Agriculture.*

**Additional prerequisites may be required for some of the courses listed. Check with your adviser.

Curriculum in Pest Management

Administered by the departments of Agronomy, Animal Ecology, Biochemistry and Biophysics, Entomology, Forestry, Horticulture, and Plant Pathology, Seed and Weed Science. Must be taken as a secondary major in conjunction with a primary major. Students with primary majors in other than the sponsoring departments are not excluded from the pest management program.

Cr.	Degree Requirements
9.5	**Communications** Engl 104, 105; Lib 160; electives
6	**Mathematical sciences** Stat 104; electives
11	**Physical sciences** Chem 163, 163L, 231, 232A; Agron 206
22-24	**Biological sciences** Biol 110, 110L, 312 or For 302; B B 301; Bot 207, 310 or 320; Gen 320; Zool 206
7	**Social sciences** Econ 201, electives
6	**Humanities**
5-6	**Agricultural sciences** Agron 114 or For 101 or For 300 or Hort 221; Agron 154 or 357
19-27	**Pest management** P M 216, 340, 376, 407 or 416, 491, 499; electives (any 2 courses from approved list*)
31.5-42.5	**Free electives****
128	**Total credits**

*An approved list of elective courses may be obtained from the pest management adviser in participating departments.

**These electives will normally be occupied by requirements of the primary major.

Typical Program for the First Year

Because pest management is a secondary major, the courses taken by the student during the first year will vary, depending on the primary major (see typical program for the primary major). It is recommended, however, that the following courses be included in the first year's program:

Cr.	
2-3	Principles of Crop Production — Agron 114 or Introduction to Forestry — For 101 or Forest Resource Management — For 300 or Principles of Horticulture — Hort 221
3	Principles of Biology — Biol 110
1	Laboratory in General Biology — Biol 110L
3	General Botany — Bot 207
3	General Zoology — Zool 206

Curriculum in Plant Pathology

Administered by the Department of Plant Pathology, Seed and Weed Sciences.

Cr.	Degree Requirements
12.5	**Communications** Engl 104, 105; Sp 211; Lib 160; electives
9	**Mathematical sciences** Stat 104; electives
13	**Physical sciences** Chem 163, 163L, 231, 232A; electives
16	**Biological sciences** Biol 110, 110L, 312; Bot 207, 306; Zool 206
7	**Social sciences** Econ 201; electives
6	**Humanities** Electives.
8	**Agricultural sciences** Agron 154, 206; electives.
13-19	**One or two areas of concentration**
26-28	**Plant pathology** Micro 300; Bot 310 or 320, 404, 406; Ent 370 or 376; Gen 320 or 330; Hort 225; PP SW 407 and 408, or 416 (5 cr.)
9.5-17.5	**Free electives**
128	**Total credits**

Typical Program for the First Year

Cr.	Fall
3	Freshman Composition — Engl 104
3 or 4	Mathematics requirement
3	Principles of Biology — Biol 110
1	Laboratory in General Biology — Biol 110L
3	Social science requirement
0.5	Library Instruction — Lib 160
R	Orientation in Plant Pathology — PP SW 110

	Spring
3	Freshman Composition — Engl 105
3 or 4	Mathematics requirement
4	General Chemistry — Chem 163
1	Laboratory in General Chemistry — Chem 163L
3	General Botany — Bot 207
3	General Zoology — Zool 206

Curriculum in Public Service and Administration in Agriculture

Administered by the Department of Sociology and Anthropology.

Cr.	Degree Requirements
11.5	**Communications** Engl 104, 105; Sp 211; Jl MC 225; Lib 160
13	**Mathematical and physical sciences** Math 150, 151; Stat 101; electives (3 cr.)
6	**Biological sciences** Biol 101; electives (3 cr.)
6	**Humanities**
15	**Sociology** Soc 110, 130, 310, 411 or 415, 420, 464
14	**Economics** Econ 201, 380, 405, 451
15	**Political science** Pol S 215, 310 or 311, 371, 475, 484
8	**Agricultural sciences**
15	**Required minor**
24.5	**Free electives**
128	**Total credits**

Typical Program for the First Year

Cr.	Fall
3	Freshman Composition — Engl 104
3	Introductory Biology — Biol 109
3	Mathematics for Business and Social Sciences I — Math 150
3	Rural Institutions and Organizations — Soc 130
4	Principles of Economics — Econ 201
R	Orientation to Public Service and Administration in Agriculture — Soc 110

	Spring
3	Freshman Composition — Engl 105
3	Mathematics for Business and Social Sciences II — Math 151
3	Fundamentals of Speech Communication — Sp 211
3	American Government: Institutions and Policies — Pol S 215
3	Biological science elective
0.5	Library Instruction — Lib 160

Curriculum in Seed Science

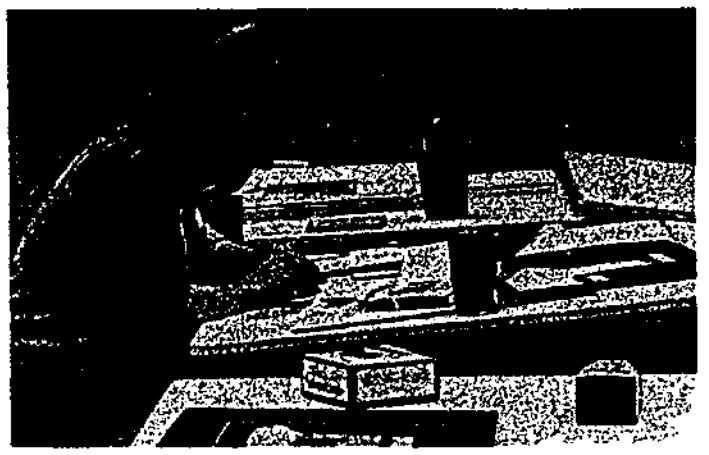
Administered by the departments of Agricultural Engineering, Agronomy, Horticulture, and Plant Pathology, Seed and Weed Science. Must be taken as a secondary major in conjunction with a primary major. The seed science program is designed for students with career interests in one or more aspects of the seed industry. Areas of study include: seed production, processing, pathology, physiology, quality control, and marketing, as well as seed plant designs.

Cr.	Degree Requirements
12.5	**Communications** Engl 104, 105; Sp 211; Lib 160; electives
11	**Mathematical sciences** Stat 101 or 104; Com S 111; electives
16-17	**Physical sciences** Chem 163, 163L, 164, 164L; B B 221 (or Chem 231, 232A); Phys (4 cr.)
21	**Biological sciences** Biol 109 or 110; Bot 207, 310; Ent 376; Gen 320; PP SW 216, 407
7	**Social sciences** Econ 201; electives
8	**Humanities** Electives.
31	**Agricultural sciences** Ag M 330, 362; Agron 154, 206, 220, 237, 354, 421; Agron 114 or Hort 221; Hort 322; Econ 335
7-9	**Seed science** PP SW 238, 438, 491
13.5-16.5	**Primary major requirements and free electives***
128	**Total credits**

*An approved list of elective courses may be obtained from the seed science adviser in administering departments.

Typical Program for the First Year

Because seed science is a secondary major, the courses taken by the student during the first year will vary, depending on the primary major (see typical program for the primary major).



College of Design

Michael P. Brooks, Dean
Herbert W. Gottfried, Associate Dean
Mary Kihl, Assistant Dean
Carole Remele Tilden, Assistant to the Dean

Departments of the College

Architecture
Art and Design
Community and Regional Planning
Landscape Architecture

The mission of the College of Design is to educate persons entering the design professions, to provide professional growth and enrichment opportunities for design practitioners, to engage in research and related activities that serve to expand and advance the design professions, and to inform the public concerning the need for and appreciation of good design practices.

The college offers opportunities to study in many design related fields, as well as a general or liberal education for personal and community roles

Recommended High School Preparation

Recommended high school preparation for students entering all departments of the College of Design includes 4 years of English composition and rhetoric. Departments, other than architecture, recommend 1½ years of algebra and 2 years of science (biology, chemistry, or physics). The Department of Architecture recommends 2 years of algebra, 1 year of geometry, ½ year of trigonometry, 1 year of physics, and 1 year of chemistry. Students in the Department of Architecture who have not had one year of high school chemistry are required to complete Chemistry 50.

For students entering all departments, high school courses in art and in drafting are highly recommended.

Professional Opportunities in Design

Graduates of the College of Design are employed in commercial and private firms, government, industry, and education. Programs of study in the college prepare students for careers in architecture, landscape architecture, environmental design, interior design, city and regional planning, advertising design, and teaching. Employment as a museum or art program director, crafts director, or studio artist are among the many other career possibilities.

Curricula in the College of Design

A student has a variety of curricula from which to choose. Each curriculum is unique, yet there are many courses common to several curricula. The major difference found among curricula is the course work related to the career or area of emphasis. Many of the programs are accredited by professional societies Each department prepares a curriculum guide available to assist students in planning their long-term programs and specifying the exact requirements for graduation Students may use their electives to broaden their education, to strengthen their area of specialization, or in some cases to meet the requirements for two programs of study

The undergraduate curricula are.
Advertising Design
Architecture
Art Education
Art and Design
Community and Regional Planning
Craft Design
General Art
Interior Design
Landscape Architecture

The graduate curricula are.
Architecture
Art and Design
Community and Regional Planning
Landscape Architecture

Advising System

Each student in the College of Design is assigned an academic adviser who is associated with the curriculum in which the student is majoring Advisers assist students in developing academic programs of study and provide information on vocational choices. Students who are uncertain of their primary direction within the college are encouraged to explore courses related to several curricula.

Requirements in the College of Design

All students in the College of Design are expected to meet the following requirements of the college

Design Core

Students will normally complete these courses during their first year

Cr.	
3	History of Design — Dsn S 121
3	Design and Society — Dsn S 137
3	Fundamentals of Visual Expression and Communication — Dsn S 140
9	Total

General Education Requirements

6	I. Biological and physical sciences and mathematics (Includes courses in the fields of agronomy, astronomy and astrophysics, biology, botany, chemistry, computer science, food and nutrition, genetics, geology, materials science and engineering, mathematics, meteorology, physics, statistics, and zoology)
6.5	II. Communications (Includes Engl 104, 105; Lib 160)
6	III. Humanities (Includes courses in the fields of foreign languages, history, literature, music theory, philosophy, religious studies, and theatre)
6	IV. Social sciences (Includes courses in the fields of anthropology, economics, family environment, geography, political science, psychology, and sociology)
24.5	Total credits

See departmental curricula for additional general education requirements

Requirements for Basic Program in the Department of Art and Design

Students are advised to seek faculty counsel regarding majoring in art and design before undertaking the following course groupings All students will complete the following course and grade-point requirements before entering a department curriculum

Cr.	Group A
6	English 104, 105*
0 5	Library 160
3-6	Biological and physical sciences and mathematics
3-6	Social sciences
3-6	Humanities
18.5	
	Group B
9	Design core* Dsn S 121, 137, 140
3-6	Art history
9-12	Art and design studio· select from Art 170, 203, 205, 220, 222, 227, 233, 235, 243, 244, 261, 270, 247 or 346 or 347, Fr E 125
24 0	
42.5	Total credits

At completion of Group A courses with a minimum 2.0 cumulative grade point average, and Group B courses with a minimum 2 5 cumulative grade point average, a student will enter a specific department curriculum. Students not achieving these minimum grade point averages will be required, if they still wish to enter a department curriculum, to take additional courses in Group A, retake courses in Group B, or under special circumstances petition for acceptance into the program.

*To meet requirements for graduation, a minimum grade of C must be received in 104 and 105.

Requirements for Professional Programs

Several curricula require portfolio review and/or a minimum cumulative grade point average at stated times during progress toward a professional degree. In some instances this occurs when students have completed a basic program or a stated group of courses, and successful fulfillment of these requirements is necessary before the student will be permitted to enroll in advanced or professional courses in the particular program.

Honors Program

The College of Design participates in the Honors Program, which encourages outstanding students to develop programs to fit their talents, abilities, or professional goals. For further information, contact the chairman of the College Honors Committee.

Design Studies

In addition to the courses taught by the four departments, the College of Design offers interdisciplinary courses. See "Design Studies" under *Courses and Programs*.

Curriculum in Advertising Design

Administered by the Department of Art and Design. Leading to the Bachelor of Arts degree Total credits required for graduation: 126.5. This curriculum is planned for students preparing to enter the professional field of advertising design Students may enter this curriculum following completion of the Basic Program in Art and Design.

Cr.	Degree Requirements
9	Biological and physical sciences and mathematics
9	Social sciences
9	Humanities
9.5	Communications Engl 104, 105, Lib 160; Engl or Sp 211 option
9	Design core Dsn S 121, 137, 140
9	Art history Art 280, 281, 389 or 391
6	Art and design studio options
36	Professional concentration Art 170, 203, 233, 235, 270, 333, 350, 358 or 359, 370, 375, 470, 471
3	Technical drawing — Fr E 125
9	Journalism and mass communication Jl MC 312, 325, 342
18	Electives
126.5	Total credits

Curriculum in Architecture

The department offers several undergraduate and graduate degree programs as follows:

A 127.5-credit undergraduate program leading to the degree Bachelor of Arts in Architecture, a preprofessional degree.

A 30-credit undergraduate program leading to the degree Bachelor of Architecture, a professional degree, following the 127.5 credit Bachelor of Arts in Architecture degree program.

Several graduate programs leading to the degree Master of Architecture, a professional degree.

(For graduate program descriptions see *Graduate Study* under *Architecture* in the *Courses and Programs* section.)

Students are advised to seek faculty counsel regarding a career in architecture prior to undertaking their Basic Group* courses.

Admission of a student into other courses in the Department of Architecture is subject to his/her having received a 2.3 cumulative grade point average in 48 credits of his/her Basic Group courses constituted from the following courses:

Cr.	Basic Group Courses
9	Dsn S 121, 137, 140
6	Social sciences or humanities
5	Phys 221
6	Engl 104, 105
11	Arch 200, 235, Fr E 145, 146
8	Math 165, 166
3	Arch 321
0.5	Lib 160

*In addition, students who are not adequately prepared may be required to take Math 140, 141, 142 and/or Chem 50, none of which may be used to satisfy credit requirements for graduation in the Department of Architecture.

Bachelor of Arts in Architecture Program

Cr.	Degree Requirements
9	Design core Dsn S 121, 137, 140
36.5	General Engl 104, 105; Lib 160; Math 165, 166; Phys 221, 222; humanities and social sciences options*
14	Visuals and graphics Arch 200, 235; Fr E 145, 146; visuals options*
20	Building sciences Arch 311, 312; C E 336, E M 301, options*
20	Design Arch 305, 306, 405 and/or 406, options*
9	History, theory, and criticism Arch 321, options*
6	Housing, urban and behavioral studies options*
13	Electives
127.5	Total credits

*Student's choice from among a faculty approved list of courses.

Bachelor of Architecture Program

Cr.	Degree Requirements
10	Design Arch 407, 408
3	History, theory, and criticism*
6	Building sciences**
8	Concentration*
3	Electives
30	Total credits

*Student's choice from among a faculty approved list of courses.

**For the first professional degree, B.Arch. or M.Arch., 10 credits in structures and 12 credits in architectural technologies are required. These 22 credits will include the 16 credits taken in structures and architectural technologies under Building Sciences in the B.A. in Architecture program. Student's choice from among a faculty approved list of courses.

Curriculum in Art and Design

Administered by the Department of Art and Design. Leading to the Bachelor of Fine Arts degree. Total credits for graduation: 145.5. This degree will prepare the student for a career in art and design or for entrance into a graduate program.

Students seeking to enter the Bachelor of Fine Arts program of study should make application after having successfully completed 65 semester credit hours, including at least 36 hours in the College of Design. A minimum 2.75 grade point average is required for courses outside of the College of Design and a 3.00 grade point average for courses in the College of Design. As part of the application process, the student will be required to present a portfolio of art and design work for review.

Cr.	Degree Requirements*
9	Biological and physical sciences and mathematics
12	Social sciences
12	Humanities
9.5	Communications Engl 104, 105; Lib 160; option
9	Design core Dsn S 121, 137, 140
30	Art and design studio options
12-15	Art history Art 280, 281, options
33-42	Professional concentration**
7-19	Electives
R	Senior BFA exhibition
145.5	Total credits

*Departmental office will provide a list of course requirements relating to specific B.F.A. programs.

**See adviser for curriculum planning.

Curriculum in Art Education

Administered by the Department of Art and Design. Leading to the Bachelor of Arts degree. Total credits for graduation: 128.5. This curriculum is planned for students preparing for certification to teach art in grades kindergarten through twelve. Students may enter this curriculum following completion of the Basic Program in Art and Design.

Cr.	Degree Requirements
9	Biological and physical sciences and mathematics
12	Social sciences** Psych 230, 312; American government; option
12	Humanities Art 280, 281; Phil 201 or 230; Phil 340
9.5	Communications Engl 104, 105; Lib 160; Sp 211
9	Design core Dsn S 121, 137, 140
3	Art history option
6	Art and design studio options
12	Professional education Psych 333; SecEd 204, 301, 406, 426
49	Professional concentration Art 212, 213, 312, 415, 417, 418; art studio options*
1	Dance
6	Electives**
128.5	Total credits

*Departmental office or adviser will provide a list of studio courses which may be used to meet this requirement.

**Might include one course from a group of approved human relations courses.

Curriculum in Community and Regional Planning

Leading to the degree Bachelor of Science. Total credits required: 128.5.

Planning areas of specialization include: administration, city as a system, economic planning, environmental planning, housing and neighborhood revitalization, human resource planning, policy development and planning, state and regional planning, transportation planning, urban design, and urban information systems.

Cr.	Degree Requirements
12.5	**Communications** Engl 104 and 105, Engl 414; Lib 160, Sp 211
9	**Humanities**
10	**Mathematics** Com S 175; Math 150; Stat 101
6	**Natural sciences**
24	**Social sciences** Econ 201; Pol S 215; Soc 134; options
9	**Design core** Dsn S 121, 137, 140
40	**Community and regional planning** C R P 253, 272, 383, 432, 492; planning and supportive options
6	**Engineering and transportation options**
12	**Electives**
128.5	**Total credits**

Curriculum in Craft Design

Administered by the Department of Art and Design. Leading to the Bachelor of Arts degree Total credits required for graduation: 126.5 This curriculum provides for a general knowledge of the craft areas and a possible concentration selected by the student among the craft areas clay, metal, structural fiber art, surface design on fabric, and wood. Students may enter this curriculum following completion of the Basic Program in Art and Design.

Cr.	Degree Requirements
9	**Biological and physical sciences and mathematics**
9	**Social sciences**
12	**Humanities**
12.5	**Communications** Engl 104, 105; Lib 160; Sp 211, option
9	**Design core** Dsn S 121, 137, 140
9	**Art history** Art 280, 281; option
6	**Art and design studio options**
39	**Professional concentration** Art 220, 222, 227, 235, 243 or 244, 247 or 346 or 347, craft design options
21	**Electives**
126.5	**Total credits**

Curriculum in General Art

Administered by the Department of Art and Design Leading to the Bachelor of Arts degree Total credits required for graduation: 126.5 This curriculum provides students with a liberal education in the visual arts. A strong general education is provided with art and design foundation courses, an art concentration, a recommended minor area, and electives. Students may enter this curriculum following completion of the Basic Program in Art and Design.

The minor must consist of 15 credits in the minor department or discipline Credits in the minor area may not be included in group requirements. Options for minors may include theatre, music, film, literature, period minors, or individual minors designed within department guidelines.

Cr.	Degree Requirements
12-14	**Biological and physical sciences and mathematics*** Biol 109 or Biol 110, astronomy, botany, chemistry, genetics, geology, mathematics, physics or zoology options
12-13	**Social sciences*** Anthro 111 or Soc 134; Pol S 215, Psych 101; anthropology, economics, political science, psychology, or sociology options
18-21	**Humanities*** Hist 201, 202; Phil 201, 340; literature, music, or speech; options
13.5-15.5	**Communications*** Engl 104, 105, 204, Lib 160, English, journalism or speech options
9	**Design core** Dsn S 121, 137, 140
12	**Art history*** Art 280, 281; options
6	**Art and design options**
12	**Art and design concentration** Select from craft design, design, drawing, drawing and fashion illustration, drawing and painting, drawing and printmaking, painting
15	**Minor area**** Select from courses outside the Department of Art and Design
9-17	**Electives**
126.5	**Total credits**

*Departmental office or adviser will provide a list of approved courses which may be used to meet requirements.

**See adviser for curriculum planning.

Curriculum in Interior Design

Administered by the Department of Art and Design. Leading to the Bachelor of Arts degree. Total credits required for graduation: 128.5. This curriculum is planned for students preparing to enter the professional field of interior design. Students may enter this curriculum following completion of the Basic Program in Art and Design.

Cr.	Degree Requirements
6	**Biological and physical sciences and mathematics** Math 105 or 150; option
10	**Social sciences** Econ 201, Soc 134, psychology option
9	**Humanities** Frnch 101; options
9.5	**Communications** Engl 104, 105; Lib 160, Sp 211
9	**Design core** Dsn S 121, 137, 140
9	**Art history** Art 280 or 281, 295, 296
6	**Art and design studio options**
34	**Professional concentration** Art 203, 261, 264, 363, 364, 367, 368, 463, 465, 469, select 247 or 346 or 347
6	**Interior design internship** — Art 369
3	**Business administration option**
3	**Technical drawing** — Fr E 125
3	**Architecture option**
6	**Family environment** F E 308, 412
4	**Textiles and clothing** — T C 204
11	**Electives**
128.5	**Total credits**

Curriculum in Landscape Architecture

The department offers a 5-year curriculum, requiring 149 5 credits, leading to the degree Bachelor of Landscape Architecture These credits are distributed between a 2-year preprofessional program of 59.5 credits and a 3-year professional program of 90 credits

Admission into the professional program is subject to the approval of a faculty committee at the completion of the preprofessional program Scholastic performance, aptitude, and personal development are the qualifications considered Preprofessional credits must average at least 2.30 on a 4.0 marking system and this minimum must be maintained through graduation

Cr.	Degree Requirements
12	**Biological and physical sciences and mathematics** Biol 109; Math 140, 141; Phys 111
9.5	**Communications** Engl 104, 105; Lib 160; Sp 211
12	**Design core** Dsn S 121, 137, 140; 145 or option
5	**Engineering** C E 215A; Con E 241
4	**Landscape architecture** — L A 241
3	**Soils** — Agron 156
9	**Biological and physical sciences** Biol 312; Bot 207; Geol 100
3	**Communications** — Engl 302
4	**Design studies option**
6	**Humanities** Phil 201 or 230, 340
48	**Landscape architecture** L A 251, 271, 321, 322, 342, 361, 443, 444, 452, 453, 462, 463, 472
6	**Plant sciences** Hort 221, 342
12	**Social sciences** C R P 270, 293; options
16	**Electives**
149.5	**Total credits**

College of Education

Virgil S. Lagomarcino, Dean
Harold E. Dilts, Associate Dean
Larry H. Ebbers, Assistant Dean

Departments of the College

Elementary Education
Industrial Education
Physical Education and Leisure Studies
Professional Studies in Education
Secondary Education

The College of Education provides degree programs leading to certification in elementary education, industrial education, and physical education as well as a professional sequence of courses for all students at Iowa State seeking a teaching certificate. In addition, the college offers certain professional programs in nonteaching fields. Certain professional programs are also available at the graduate level.

A person who is to work effectively with people needs broad personal and professional knowledge and understanding. The College of Education strives to provide each student with a sound general education as well as preparation in an area of specialization.

In addition, a prospective teacher must have an understanding of teaching and of learning, and skill in applying such understanding in the classroom. An awareness of the characteristics of growth and development of students and the role of learning in society is also needed.

The teacher education program at Iowa State University is accredited by the National Council for Accreditation of Teacher Education. All students who are recommended by Iowa State University for teacher certification must meet the requirements of the teacher education program and be recommended by the College of Education. Each student will be enrolled in the department in which he or she plans to major and must meet the graduation requirements of that department and the college in which it is located.

Recommended High School Preparation

Students will find it beneficial to have at least three years of English/speech with emphasis in composition and communication skills and a general background in mathematics, natural sciences, social sciences, and humanities.

Curricula and Special Programs in the College of Education

Elementary Education — curriculum in *elementary education*, with areas of concentration in most academic disciplines, the exceptional child, the culturally different child and a sequence of courses for approval in mental disabilities and in reading. Certification programs at the graduate level in emotional disabilities and learning disabilities. Additional graduate work in elementary education and in gifted and talented.

Industrial Education — curriculum in *industrial education*, with industrial arts teaching option, industrial vocational-technical education option, the industrial option, and the occupational and traffic safety education option.

Physical Education — curricula in *physical education* and *leisure studies*. Departmental offerings include the physical education K-12 and secondary certification options with specialization opportunities available in athletic training, coaching, and dance; the physical education general (non-certification) option; the dance (non-certification) option; the coaching endorsement; the health certification program; and a major program in leisure studies.

Professional Studies in Education — All graduate programs are based upon a *major in education*, with specializations in adult and extension education; educational administration; counselor education; curriculum and instructional media; higher education; historical, philosophical and comparative education; research and evaluation; elementary education; and learning disabilities.

Secondary Education — Provides *certification* programs in conjunction with subject matter areas of agriculture, art, biology, chemistry, earth sciences, English, foreign languages, general sciences, home economics, journalism and mass communication, mathematics, music, physical science, physics, psychology, social studies, and speech.

Environmental Studies (second major only) — The College of Education participates in the Environmental Studies Program and offers a major in environmental studies that may be taken only as a second major. Students pursuing a second major in environmental studies must complete the Environmental Studies Program as described in this catalog (see Index, *Environmental Studies).*

Admission to Undergraduate Teacher Education Program

A student seeking admission to a teacher education program must be accepted by a selection committee for the specific program which he or she seeks to enter. Factors considered in evaluating applications include scholarship, interest in teaching, character, and physical and mental health. Recommendations by selection committees must be confirmed by the University Committee on Teacher Education before admission to the program in teacher education is granted.

Students *may* apply as early as three semesters before the one in which they plan to enroll for student teaching; however, they *must* be fully admitted into the Teacher Education Program by mid-semester prior to their planned student teaching semester. A 2.3 quality-point average is required for full admission to the teacher education program and this minimum average must be maintained through graduation.

The General Education Requirement

Students in the College of Education and all prospective teachers are required to complete a program in general education which is integrated with their professional training and extends through the undergraduate curriculum.

The general education program emphasizes intellectual growth and personal development as contrasted with specific vocational preparation. It is recognized that many contributions to general education may be made by courses which have other primary objectives.

The program aims to stimulate a desire for learning and intellectual endeavor, develop understanding and appreciation for the physical and cultural world, encourage independent thinking and analysis, increase competence in all aspects of communication, and create an understanding of individuals as social, psychological, and physical beings.

The student is expected to complete studies in five groups in general education. Areas represented below are not departmental titles. In some cases, courses relating to a given area may be found in several different departments. Credits listed are minimum requirements.

Cr.	
9	I. Biological sciences, physical sciences, and mathematics
9	II. Social sciences
6	III. Humanities
9	IV. Communication skills
1	V. Health, dance, physical education, safety
34	
8	Additional credits in above areas
42	

A student must have 42 semester hours in general education outside his or her academic major or minor, with the minimum in each area as shown above. This total will include Engl 104 and 105, Sp 211 or equivalent, and Lib 160. Additional credits in general education may be required by departments preparing teachers.

Teacher Certification

The Iowa Professional Certificate may be recommended for those who hold the bachelor's degree from Iowa State and who have completed the following:

1. All requirements of an approved teacher education program, including the human relations requirement of SecEd/ElEd 406 and one course designated as appropriate for the human relations requirement.

2. A minimum of 42 semester hours in courses designed to serve the general needs of college students. This total will include Engl 104 and 105, Sp 211 or equivalent, Psych 230, one course in American history or American government, and Lib 160.

For *full-time teaching in secondary schools* an approved subject matter concentration of at least 30 semester hours is required. A second subject matter area of at least 20 semester hours is possible but not required.

Approval for the nursery school-kindergarten certificate requires the successful completion of that curriculum in the Department of Child Development.

Graduate programs are available for those who seek approval as elementary and secondary school principals, superintendents, counselors, instructional media specialists, or teachers in junior and community colleges. Students also may pursue a program for approval to teach in the area of learning disabilities and/or emotional disabilities.

Approval for the school psychologist certificate requires the successful completion of that curriculum in the Department of Psychology.

Information concerning certificates not described above, as well as more detailed requirements for any certificate, may be obtained from the Dean of the College of Education.

The Professional Teacher Education Requirement

As part of a total educational program, the prospective teacher must complete certain studies related directly to the profession of teaching. All students in teacher education take the following courses:

Cr.	
3	The School in American Life — SecEd/El Ed 204
1	Instructional Media — SecEd/El Ed 301
3	Educational Psychology — Psych 333
2	Multicultural Awareness and Non-sexism in the Classroom — SecEd/El Ed 406

The additional courses required by specific teaching areas are.

Elementary Education
See *Curriculum in Elementary Education*

Prekindergarten-Kindergarten Education
See Index, *Child Development* for complete requirements.

Secondary Education

Cr.	
3 or 4	Principles and Issues of Secondary Education — SecEd 426
8	Student teaching (minimum — 8 weeks)

Professional Courses in Areas of Specialization

Ag Ed 211, 311, 410, 411, 417
Art 212, 213, 312, 415, 417, 418
Biology — S-H 417D, 486.
Chemistry — S-H 417B, 486.
Earth Science — S-H 417J, 486.
English — Engl 494, S-H 417E.
Foreign Languages — F Lng 476, S-H 417G.
General Science — S-H 417B, 486.
Health Education — H S 375, 417, 418.
Home Economics Education — H Ed 410, 412, 417.
Industrial Education — I Ed 217, 312, 415, 417
Journalism — Jl MC 480, S-H 417I
Mathematics — Math 497, S-H 417C
Music — Music 464, 465, 466, S-H 417K or 417L.
Physical Education — P E 375, 417, 418, 475
Physics — S-H 417B, 486
Safety Education — Saf 317, 416, 415
Social Studies — S-H 417A, 487
Speech — Sp 495, S-H 417F

The Requirements for Areas of Specialization in Teacher Education

A teacher must also be competent in the area of a teaching specialization. Certain competencies are required of those who would teach at prekindergarten-kindergarten or the elementary level, for instance, while a depth of knowledge in some particular subject matter is necessary for those who would be teachers at the secondary level.

Agricultural Education
See *Curriculum, Agriculture.*

Art
See *Curriculum, Art Education, Department of Art and Design*

Biology
See *Sciences and Humanities, Cross-Disciplinary Studies, Teacher Education Programs, Subject Matter Courses.*

Chemistry
See *Sciences and Humanities, Cross-Disciplinary Studies, Teacher Education Programs, Subject Matter Courses.*

Coaching Interscholastic Athletics
Students seeking endorsement to coach interscholastic athletics must:

a Satisfy the professional teacher education requirements of the College of Education

b Satisfy the requirements of a teaching specialization area.

c Earn credits in the following. P E 220 (prereq. Zool 156), 301-312 (select one course), 355 (prereq. Physics 101 or 106 or 111), 402, 455, 486.

Earth Sciences
See *Sciences and Humanities, Cross-Disciplinary Studies, Teacher Education Programs, Subject Matter Courses*

Elementary Education
See *Curriculum, Elementary Education*

English
See *Sciences and Humanities, Cross-Disciplinary Studies, Teacher Education Programs, Subject Matter Courses*

Foreign Languages
See *Sciences and Humanities, Cross-Disciplinary Studies, Teacher Education Programs, Subject Matter Courses.*

General Science
See *Sciences and Humanities, Cross-Disciplinary Studies, Teacher Education Programs, Subject Matter Courses.*

Health Education
Students seeking approval to teach *health education* must earn credits in the following courses: H S 110, 215, 250, 305, 310, 390; F N 107; PE 163; Psych 360 or 382 or 460; U St 221 or 222 or 425 or Saf 201; Soc 219 or 327 or Zool 258; Soc 485 or F E 201; Zool 155, 156.

Students seeking approval for *health education* as a second subject area must earn credits in the following courses: H S 110, 215, 250, 305, 310, 390; F N 107; Soc 327 or 485 or F E 201 or Zool 258; Zool 155, 156.

Home Economics
See *Curriculum, Home Economics.*

Industrial Education
See *Curriculum, Industrial Education.*

Journalism and Mass Communication
See *Sciences and Humanities, Cross-Disciplinary Studies, Teacher Education Programs, Subject Matter Courses.*

Mathematics
See *Sciences and Humanities, Cross-Disciplinary Studies, Teacher Education Programs, Subject Matter Courses.*

Music
See *Sciences and Humanities, Cross-Disciplinary Studies, Teacher Education Programs, Subject Matter Courses.*

Physical Education
See *Curriculum, Physical Education*

Physical Science
See *Sciences and Humanities, Cross-Disciplinary Studies, Teacher Education Programs, Subject Matter Courses*

Physics
See *Sciences and Humanities, Cross-Disciplinary Studies, Teacher Education Programs, Subject Matter Courses.*

Prekindergarten-Kindergarten Education
See Index, *Child Development* for complete requirements.

Safety Education and Driver Education
All students who qualify for approval to teach safety education and driver education must have preparation in some major area of specialization. Such students then may obtain approval to teach safety education and driver education by earning the following credits

18 semester hours required
Saf 201, 208, 317, 415, 416
H S 215.
3 semester hours chosen from
Saf 210, 401, 420, 430, 490;
H S 105, 110; Psych 211, 312, Soc 264

Social Studies
See Sciences and Humanities, Cross-Disciplinary Studies, Teacher Education Programs, Subject Matter Courses.

Speech
See Sciences and Humanities, Cross-Disciplinary Studies, Teacher Education Programs, Subject Matter Courses.

Advisers for Areas of Specialization in Teacher Education

Persons interested in teaching in one of the following areas should consult with the appropriate individual. Details of each area will be found in the appropriate departmental section.

Elementary Education
Jess Beard.

Prekindergarten-Kindergarten
Child Development — Samuel Clark.

Secondary Education
Agricultural Education — Harold Crawford.
Art — Dennis Dake.
Biology — George Knaphus.
Chemistry — Wilbert Hutton.
Earth Sciences — Frederick DeLuca.
English — Richard Zbaracki.
Foreign Languages — Walter Chatfield.
General Science — George Knaphus, Frederick DeLuca.
Health Education — Frank Schabel.
Home Economics Education — Rosalie Amos
Industrial Education — William Wolansky.
Journalism — Richard Kielbowicz
Mathematics — William Rudolph.
Music — David Woods.
Physical Education — Shirley Wood.
Physical Sciences — Frederick DeLuca, James Dixon, Wilbert Hutton
Physics — James E. Dixon.
Safety Education — William Wolansky.
Social Studies (economics, sociology, government, geography, and history) — Clair Keller.
Speech — Frances Langford.

Undergraduate Curriculum in the College of Education

Undergraduate students planning to major in elementary education, industrial education, physical education, or leisure studies will enroll in the College of Education.

Students may also qualify through the College of Education for approval to teach health education, safety and driver education, or for endorsement to coach interscholastic athletics. Students seeking either safety and driver education approval or the coaching endorsement must also qualify for approval to teach in some major area of work (see Index, *Industrial Education, Courses and Programs; Physical Education, Courses and Programs).*

Each student will have a faculty adviser in his or her chosen curriculum to aid in planning a program.

Curricula for elementary education, industrial education, leisure studies, and physical education follow (see departments for curriculum).

Curriculum in Elementary Education

The curriculum in elementary education is planned for students preparing to teach in grades kindergarten through six. For additional information see Index, *Courses and Programs.*

Total credits required — 128.

Cr.	
45	**General Education***
12.5	**Communication skills** Engl 104 (3), 105 (3), Sp 211 (3), Library 160 (0.5)
9	**Social sciences** Psych 230 (3), Pol S 215 (3)
6	**Humanities**
2.5	**Health, dance, physical education, safety**
12	**Sciences and math** Biological science — 1 course minimum Physical sciences — 1 course minimum Math — 3 cr. minimum (select from Math 105, 150, 195)
3	**Additional credits (from above areas)**
47	**Elementary Education**
7	**Block I** (3 courses taken concurrently) 204 (3), 250 (3), 280 (1)
10	**Block II** (4 courses taken concurrently) 345 (3), 375 (4), 301 (1), 468 (2)
16	**Block III** (both taken during the same semester) 417A (or C) (8), 417B (or C) (8)
8	**Required:** 445 (4), 446 (4)
6	**Select from:** 360 (3), 447 (3), 450 (3), 460 (3), 475 (3)
	Related Courses
8	**Required core** Psych 333 (3), El Ed 406 (2), C D 226 (3)
6	**Options** (select from) C D 240 (3); Sp 275 (3), Art 212 (4); Sp 362 (3); H S 105 (2); U St 225 (3); H S 275 (2), P E 284 (3); Music 365 (3)
15	**Area of Concentration** Courses selected for an in-depth study of an area in which the student is interested and which is relevant to elementary school teaching.
7	**Electives** (unrestricted)
	Orientation: Required Freshman Orientation — El Ed 100 Sophomore Orientation — El Ed 200 Transfer Orientation — El Ed 300

*Refer to departmental curriculum sheet for specific course requirements.

Curriculum in Industrial Education

The curriculum in industrial education is planned for students preparing to teach or to enter industry. The teaching option provides preparation for teaching of industrial arts in junior or senior high schools, or traffic safety education, or to secure industrial vocational-technical certification with endorsement 71. Within selected apprenticeable occupations, credits may be earned through competency examinations. The industrial option provides preparation for employment in business or industry, particularly in personnel, sales, communication, contracting and construction, maintenance, production, or occupational safety.

Total credits required: 128

For additional information see Index, *Courses and Programs.*

Cr.	
42	**General Education**
10	**Physical sciences, mathematics** Chem 160 (3 cr.), Phys 106 (4 cr.), Math 142 (3 cr.)
13	**Social sciences** **Teaching Option and I.V.T.E.:** Psych 230 (3 cr.); Econ 201 (4 cr.), Pol S 215 (3 cr.), Soc 134 (3 cr.) **Industrial Option and Safety:** Psych 101 (3 cr.); Econ 201 (4 cr.), Pol S 215 (3 cr.), Soc 134 (3 cr.)
6	**Humanities** History (3 cr.) plus 3 other credits in humanities
9.5	**Communication skills** Engl 104 (3 cr.), Engl 105 (3 cr.), Sp 211 (3 cr.); Lib 160 (0.5 cr.)
3.5	**Health, dance, physical education, and safety** **Industrial Option:** Saf 201 (3 cr.); P E (0.5 cr.) **Teaching Option, I.V.T.E., and Safety** 1 credit in health, dance, physical education and safety; 2.5 credits in any other general education courses
	Industrial Education Options
	A. Industrial Arts Teaching Option
43	**Technical core** (Consists of three clusters: E & P, GC, and M&P.)
1	Introduction to Industrial Education — I Ed 110
3	Introduction to Graphic Communication — I Ed 120
3	Introduction to Materials and Processes — I Ed 130
3	Introduction to Energy — I Ed 140
3	Graphic Image Generation — I Ed 221
3	Industrial Materials and Processes — I Ed 231
3	Energy and Power Systems — I Ed 240
3	Industrial Enterprise System — I Ed 480
3	Facility Planning and Management — I Ed 410
	The student will also be required to take the following:
6	One additional course in each of two of the three clusters at the 200 level
6	6 I Ed credits at the 300 level
6	6 I Ed credits at the 400 level
40	**Professional**
3	Foundations of American Education — SecEd 204
1	Instructional Media — SecEd 301

3 Principles and Issues of American Education — SecEd 426
2 Multicultural Awareness and Non-sexism in the Classroom — Sec Ed406
2 Introduction to and Observation in Industrial Arts Teaching — I Ed 217
3 School Laboratory Safety — I Ed 310
3 Foundations of Industrial Arts — I Ed 312
4 Methods of Teaching Industrial Arts — I Ed 415
16 Supervised Student Teaching — I Ed 417A (8 cr.), B (8 cr.)
3 Educational Psychology — Psych 333
3 Electives

Cr. **B. Industrial Option**
43 Technical core (same as Option A)
29 Professional
3 Computer Programming
3 Business Communications — Engl 302 (3 cr.) or Writing of Professional Papers and Reports — Engl 414 (3 cr)
2 Industrial Accounting — Acct 381
3 Industrial Organization and Work Analysis — I E 375
2 Human Resource Management — I E 424
4 Mathematics or statistics
3 Psychology — Psych 450
3 Business and Professional Speaking — Sp 312 (3 cr.) or Persuasion — Sp 327 (3 cr), or Group Discussion and Leadership — Sp 317 (3 cr.)
3 Fluid Power — I Ed 445
3 Handling of Products and Hazardous Materials — Saf 315
14 **Electives**
Students are encouraged to select electives from the following subject matter areas· architecture, computer science, economics, English, forestry, business administration, industrial engineering, journalism, mathematics, physics, psychology, speech

Cr. **C. Industrial Vocational Technical Education (I.V.T.E.)**
38 Technical core
0-30 **Teaching specialty** — I.V.T.E 300
300. Occupational Competency. Cr up to 30 semester hours. Prereq. Approval from department head, enrolled in B S degree (I.V.T.E.) and have planned program leading to endorsement 71 (post secondary), have met the industrial experience requirement for vocational approval, have junior classification, have completed 15 (quarter) credits at I.S.U. prior to receiving credit for occupational competency. Competence in the following occupational clusters is determined through completion of oral, written, and performance examinations See Industrial Education Department Competency Test Program guidelines for additional information.
A. Automotive and Power Mechanics
B. Building Trades
C. Commercial Art
D. Drafting and Graphics
E. Electricity-Electronics
F. Metal Trades
6 Courses related to specialization
2 Courses not related to specialization
I.V.T.E. students not enrolled in the occupational competency program (IVTE 300) described above will select 30 credit hours from the technical core group for Option A. The courses selected will be approved in accordance with the specialty chosen

36 Professional
3 Educational Psychology — Psych 333
3 Orientation to Teaching Industrial Vocational Technical Education Programs — IVTE 380
2 Foundations of I.V.T E. — IVTE 381
2 Occupational Analysis and Course Construction in I.V T E. — IVTE 382
3 Techniques of Teaching I.V T E. — IVTE 383
4 Facility Planning, Organization and Management of the I V.T.E. Laboratory — IVTE 384
2 Evaluation in I V T E — IVTE 491
3 Coordination and Administration of I V T E — IVTE 492
3 Human and Public Relations for Industrial Vocational Technical Education — IVTE 493
3 Supervision and Administration of I.V T.E. — IVTE 494
3 Career Development Teaching Practices in I V T E — IVTE 495
3 School Laboratory Safety — I Ed 310
2 Multicultural Awareness and Non-sexism in the Classroom — SecEd 406
12 **Electives**

Cr. **D. Occupational and Traffic Safety Option**
1. Occupational Safety
25 Technical core
1 Introduction to Industrial Education — I Ed 110
3 Introduction to Graphic Communication — I Ed 120
3 Introduction to Materials and Processes — I Ed 130
3 Introduction to Energy — I Ed 140
3 Graphic Image Generation — I Ed 221
3 Industrial Materials and Processes — I Ed 231
3 Energy and Power Systems — I Ed 240
3 Handling of Products and Hazardous Materials — Saf 315
3 Instrumentation for Industrial Hygiene — Saf 471
37 Professional sequence
3 Principles of Accident Prevention — Saf 201
3 Occupational Safety — Saf 202
3 Highway Transportation System·Driver Task Analysis — Saf 208
3 Accident Investigation and Records — Saf 210
3 Legal Aspects of the Occupational Safety and Health Act — Saf 330
3 Fire Protection and Prevention — Saf 360
3 Industrial Hygiene — Saf 470
2 Ergonomics in Work System Design — I E 274
2 Human Resource Management 1 — I E 424
3 Human Resource Management 2 — I E 425
3 Industrial Organization and Work Analysis — I E 375
3 Industrial Psychology — Psych 450
3 Writing of Professional Papers and Reports — Engl 414
12 Related courses (select 12 credits from below)
3 Industrial Computer Techniques — I E 209
2 Analysis for Engineering Economy — I E 304
3 Industrial Quality Control and Inspection — I E 361
1 First Aid and Emergency Care — H S 105
2 Drug Education — H S 215
3 Publicity and Public Relations — Jl MC 225
3 General Insurance — I A S 357
3 Small Group Dynamics — Soc 264
3 Persuasion — Sp 327
3 Introduction to Business Statistics — Stat 227
3 Labor Economics — Econ 404
1-4 Safety Internship — Saf 430
3 Energy Applications — I Ed 242
3 Industrial and Construction Safety — I Ed 311
3 Techniques of Teaching IVTE — IVTE 383
12 **Electives**
Students are encouraged to select electives from the following subject matter areas economics, business administration, industrial engineering, mechanical engineering, psychology, physics, speech

2. Traffic Safety Education
10 Technical Courses
3 Highway Transportation System-Driver Task Analysis — Saf 208
3 Theory and Practicum of Multiple-Car and Behind the Wheel Instr — Saf 317
4 Theory and Practicum of Simulation and Behind the Wheel Instr. — Saf 416

8 **Professional courses**
3 Principles of Accident Prevention — Saf 201
3 Theory and Practicum of Classroom Teaching of Driver Education — Saf 415
2 Drug Education — H S 215
3 Related courses (select 3 credits from below)
3 Accident Investigation and Records — Saf 210
3 Perception and Safety — Saf 401
1-4 Safety Internship — Saf 430
1-4 Independent Study in Safety Education — Saf 490
3 Motorcycle Safety Instruction — Saf 420
1 First Aid and Emergency Care — H S 105
3 Personal and Consumer Health — H S 110
3 Experimental Psychology of Thinking — Psych 211
3 Sensation and Perception — Psych 312
3 Small Group Dynamics — Soc 264

Curriculum in Leisure Studies

Administered by the Department of Physical Education and Leisure Studies. The curriculum in leisure studies is planned for students preparing to enter the recreation/parks or leisure services profession. For additional information, see Index, *Courses and Programs.*

Total credits required: 128 (46 credits in courses numbered 300 or above).

Cr.
42 General Education*
Biological sciences, physical sciences, mathematics (minimum credits 11)
4 Principles of Statistics — Stat 101
3 Basic Human Physiology and Anatomy — Zool 155
Social sciences (minimum credits 13)
3 American Government: Institutions and Policies — Pol S 215
3 Rural Institutions and Organizations — Soc 130 or Introduction to Sociology — Soc 134
3 General Psychology — Psych 101
4 Principles of Economics — Econ 210
Humanities (minimum credits 6)
Communication skills (minimum credits 9.5)
0.5 Library Instruction — Lib 160
6 Freshman Composition — Engl 104, 105
3 Fundamentals of Speech Communication — Sp 211
Health, safety, physical education, and dance (minimum credits 2.5)
0.5 Camping Skills and Techniques — P E 176
61 Major
34 Core
R Orientation to Leisure Studies — L S 100
3 Leisure and Recreation: Concepts and Services — L S 201
2 Introduction to Professional Services — L S 283
4 Leadership, Services, and Programs — L S 350
2 Outdoor Recreation: Concepts and Practices — L S 351
3 Dimensions of Recreation in the Campus Community — L S 355
2 Practicum in Leisure Services — L S 383
2 Leisure and Recreation in Relation to Special Populations — L S 394
4 Administration of Leisure Services — L S 453
12 Internship in Leisure Services — L S 483
27 Pan Disciplinary
2 First Aid and Emergency Care — H S 105
3 Principles of Accounting — Acct 284
3 Principles of Organization and Management — Mgmt 370
2 Planning Recreation Systems — L A 301
3 Forest Recreation Resource Management — For 360
3 State and Local Government — Pol S 310
3 Psychology — optional course, 300 level or above
3 Small Group Dynamics — Soc 264
3 Sociology of Leisure and Recreation — Soc 383
2 Publicity and Public Relations — Jl MC 225
25 Electives

*Refer to department-approved list of courses

Curriculum in Physical Education

The curriculum in physical education is planned for students preparing to teach physical education or to enter related professional areas. The student majoring in physical education may select one of three options: a) physical education certification, b) physical education general (non-teaching), or c) dance. The teaching option leads to certification to teach physical education in grades 7-12 or K-12. The general physical education option is planned for students who are interested in an interdisciplinary approach to the study of human movement. The individualized dance option provides students with a comprehensive view of dance as both a physical skill and a creative art form.

Total credits required: 128 (46 credits in courses numbered 300 or above).

Cr.
42 General Education*
Biological sciences, physical sciences, mathematics (minimum credits 11)
3 Basic Human Physiology and Anatomy — Zool 155
2 Laboratory in Human Physiology and Anatomy — Zool 156
3 Principles of Human Nutrition — F N 107
3-4 Physics — select from 101, 106, 111
Social sciences** (minimum credits 9)
3 General Psychology — Psych 101
3 Introduction to Sociology — Soc 134
3 Developmental Psychology — Psych 230
Humanities** (minimum credits 6)
Communication skills (minimum credits 9.5)
6 Freshman Composition — Engl 104, 105
3 Fundamentals of Speech Communication — Sp 211
0.5 Library Instruction — Lib 160
Health, safety, physical education, and dance (minimum credits 5)
2 First Aid and Emergency Health Care — H S 105
3 Personal and Consumer Health — H S 110

*Refer to the department-approved list of courses.

**All teacher certification students must complete one 3-credit course in American history or government.

17 Core requirements
R Physical Education Orientation — P E 250
3 History and Philosophy of Physical Education — P E 260
1 Perspectives of Physical Education — P E 270
4 Kinesiology — P E 355
3 Social-Psychological Aspects of Movement — P E 360
3 Principles of Motor Performance — P E 370
3 Physiology of Exercise — P E 455

Options
Physical education certification option (7-12)
Professional education requirements (minimum credits 20)
3 Educational Psychology — Psych 333
3 Foundations of American Education — SecEd 204
1 Instructional Media — SecEd 301
2 Multicultural Awareness and Non-sexism in the Classroom — SecEd 406
3 Principles of Secondary Education — SecEd 426

8 Supervised Teaching in Physical Education in the Secondary School — P E 417

Physical Education professional theory (minimum credits 17)

1 Teacher Aid — SecEd 280
3 Teaching Physical Education — P E 375
1 Teaching Gymastics — P E 380
1-2 Basic Aquatic Methods — P E 382 or Water Safety Instructor — P E 115
2 Teaching Modern and Recreational Dance — Dance 385
3 Adapted Physical Education — P E 395
3 Evaluation in Physical Education — P E 470
3 Physical Education Curriculum Design and Program Organization — P E 475

Physical education professional activity skills (minimum credits 11)

Team sports (4 courses)*
Individual and leisure sports (6 courses)*
Gymnastics (1 course)*
Aquatics (1 course)*
Physical fitness (1 course)*
Dance (4 courses)*
Rhythmic analysis (1 course)*

Electives (total credits 21)

*Refer to the department-approved list of courses

Specialization Opportunities

Specialization areas are designed to allow physical education majors to be certified or to complete additional work in the following areas: elementary physical education (K-6), dance, athletic training, coaching and health education

Elementary physical education
The elementary physical education specialization leads to certification to teach physical education in the elementary school

3 Movement Education in Elementary School Physical Education — P E 275
1 Directed Field Experience in Elementary School Physical Education — P E 280
2 Teaching Children's Dance — P E 384
3 Development and Guidance in Middle Childhood — C D 226
8 Supervised Teaching in Physical Education in the Elementary School — P E 418

Dance
General education hours must include 9 credits in the humanities.

2 Dance Appreciation — Dance 270
2 Sound and Movement — Dance 320
History and Philosophy of Dance — Dance 360 (may be substituted for the PE 260 core requirement)
2 Teaching Dance Technique and Composition — Dance 386 or Teaching Children's Dance — P E 384
2 5 Dance activities (select 5 dance courses)

Athletic training
The athletic training concentration is designed to prepare the student for the National Certification Examination in Athletic Training

3 Introduction to Athletic Training — P E 225
2 Advanced Athletic Training — P E 325
2 Athletic Training Modalities and Rehabilitation — P E 425
3 Practicum in Athletic Training — P E 488
1-2 Coaching theory: select 1 from PE 301-312
2 Drug Education — H S 215

Coaching

2 Athletic Training for Coaches — P E 220
1-2 Coaching theory: select 1 from P E 301-312
1-3 Supervised Coaching in Interscholastic Athletics — P E 486

Health
The health specialization leads to certification to teach health education in the secondary school (For specific requirements, see *College of Education, Curricula.)*

Physical education general option
(non-teaching)
This major is planned for students who are interested in an interdisciplinary approach to the study of human movement. With this major come opportunities for careers with recreational agencies, media, institutions, industries, and research labs in universities or colleges. Students choosing this option devise an individualized program of study to meet individual needs and interests.

In addition to the core curriculum requirements, the following courses are to be completed·

4 **Physical education activities**
Select 4 credits from courses numbered 101 through 199
6 **Physical education professional courses**
Select 6 credits from physical education courses numbered 250 or above
20 **Area of specialization**
Area and program must be approved by the Department of Physical Education
Leisure Studies (physical activity specialist)
Health Related Fields (pre-therapy)
Fitness/Commercial Health
Sports Journalism/Advertisement
Individualized Program
39 **Electives**

Dance option
The dance option provides opportunities for students to develop dance talents through an individualized program of study. Choreography, performance, and work in dance production are important parts of this curriculum. The undergraduate program provides a good foundation for graduate work or for entrance into programs of dance therapy, Effort/Shape, and/or Laban studies Dance personnel are often needed in community and professional theater, private dance studios, summer camps, artist-in-school programs, recreational centers, and universities.

General education modifications
F N 107 and H S 110 deleted as requirements
10 credits required in humanities
9 credits required in biological and physical sciences, mathematics
2 credits required in health, safety, physical education, and dance

Physical education core modifications
Dance 270 and 360 may be substituted for the P E 270 and 260 requirements

25 **Required dance courses**
1 Rhythmic Aspects of Movement — P E 187
1 Modern Dance I — Dance 120
2 Modern Dance Composition I — Dance 220
1 Modern Dance II — Dance 222
2 Sound and Movement — Dance 320
2 Advanced Studies in Dance — Dance 370 or Independent Study — Dance 490
2 Teaching Dance Technique and Composition — Dance 386 or Teaching Children's Dance — P E 384
14 Select a minimum of 16 credits from dance courses numbered 115-490
12 **Area of specialization**
Area and program must be approved by the Department of Physical Education.
31 **Electives**

College of Engineering

David R. Boylan, Dean
Paul E. Morgan, Associate Dean for Academic Affairs
Paul W. Peterson, Associate Dean for Research
Paul W. Barcus, Assistant Dean
Rolland C. Knight, Assistant to the Dean
George K. Serovy, Assistant to the Dean

Departments of the College

Aerospace Engineering
Agricultural Engineering
Chemical Engineering
Civil Engineering
Electrical Engineering
Engineering Science and Mechanics
Freshman Engineering
Industrial Engineering
Materials Science and Engineering
Mechanical Engineering
Nuclear Engineering

The engineer occupies a uniquely important position in our modern civilization. He or she has the responsibility for taking the discoveries of basic science and translating them into products, structures, facilities, and services for the use of mankind.

Objectives of Curricula in Engineering

The broad objectives of engineering education are to develop professional competence and, by breadth of study, to prepare students for participation as leaders in the affairs of their professions, their communities, the state, and the nation. Engineering education seeks to develop a capacity for objective and analytical thought.

The curricula in engineering provide a balanced program in mathematics, basic sciences, engineering sciences, engineering design, social sciences, and humanities. This content is consistent with recommendations of the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (EAC/ABET), the national engineering accrediting agency.

Registration as a professional engineer, which is granted by the individual states, is required for many types of positions. The professional curricula in engineering at Iowa State University are designed to prepare a graduate for subsequent registration in all states. Seniors in EAC/ABET accredited curricula of the College of Engineering may take the Fundamentals Examination for professional registration during their final academic year. Seniors in the surveying curriculum and seniors in other engineering curricula who have obtained at least 14 semester credits in surveying may take the Fundamentals Examination for professional registration as land surveyors.

Advanced work in engineering is offered in the post-graduate programs. See the *Graduate College* section of this catalog

Curricula and Administering Departments*

Curriculum	Administering department	See key below
Aerospace Engineering	Aerospace Engineering	A B C D E F
Agricultural Engineering	Agricultural Engineering	A B C D E F
Biomedical Engineering	Multi-departmental	E F
Ceramic Engineering	Materials Science and Engineering	A C E F
Chemical Engineering	Chemical Engineering	A B C D E F
Civil Engineering	Civil Engineering	A B C E F
Computer Engineering	Electrical Engineering	A B C
Construction Engineering	Civil Engineering	A B C
Electrical Engineering	Electrical Engineering	A B C D E F
Engineering Mechanics	Engineering Science and Mechanics	D E F
Engineering Operations	Industrial Engineering	A B
Engineering Science	Engineering Science and Mechanics	A B C
Industrial Engineering	Industrial Engineering	A B C D E F
Mechanical Engineering	Mechanical Engineering	A B C E F
Metallurgical Engineering	Materials Science and Engineering	A B C
Metallurgy	Materials Science and Engineering	E F
Materials Science and Engineering	Materials Science and Engineering	D
Nuclear Engineering†	Nuclear Engineering	A B C D E F
Surveying	Civil Engineering	A B ‡

Key:
A - Offers 4 year Bachelor of Science (B.S.) degree
B - Offers 5 year Bachelor of Science degree (co-op program)
C - Undergraduate program accredited by EAC/ABET
D - Offers Master of Engineering (M.Engr.) degree
E - Offers Master of Science (M.S.) degree
F - Offers Doctor of Philosophy (Ph.D.) degree
* - The College also has a Department of Freshman Engineering (See page 132.)
† - Master of Engineering program accredited at advanced level by EAC/ABET
‡ - Geodesy and Photogrammetry administered by Civil Engineering.

Organization of Curricula

All curricula in engineering are divided into two phases: a basic program and a professional program. The basic program consists primarily of subjects fundamental and common to all branches of engineering and includes chemistry, physics, mathematics, engineering graphics, engineering computations, and English. A student who has adequate high school preparation is expected to complete the basic program in one year. The professional phase of a curriculum includes intensive study in the particular branch of engineering which a student chooses, as well as a continuation of supporting work in mathematics, basic sciences, humanities, and social sciences.

Preparation for the Engineering Curricula

Recommended preparation for students entering the College of Engineering is 2 years of algebra, 1 year of geometry, ½ year of trigonometry, as well as a year each of physics and chemistry. Without this background in mathematics and science, it may take longer than 4 years to earn a degree in engineering. Students must complete the requirements of the basic program before proceeding to the professional engineering curriculum of their choice.

Basic Program for Professional Engineering Curricula

The first year program is much the same for all professional curricula in the College of Engineering. Each curriculum requires completion of the basic program as well as the curriculum designated requirements. The basic program is a set of core courses common to all engineering curricula, while the curriculum designated requirements are courses required by individual curricula. Because of the curriculum designated requirements, there are some differences among curricula. The student who desires to receive the bachelor's degree in a minimum time will find it desirable to select a curriculum as soon as possible.

Basic Program*

Cr.	
8 or 10	Mathematics 165, 166 or 175, 176
6	English 104, 105
5	Freshman Engineering 155, 165
4	Chemistry 167 or 177
5	Physics 221
R	Freshman Engineering 101**
0.5	Library 160
28.5 or 30.5	Total credits

*Students who are not adequately prepared may have to take Math 140, 141, 142 and/or Chem 50 in addition to the courses listed above. Neither Math 140, 141, 142 nor Chem 50 may be used to satisfy credit requirements for graduation in any of the engineering curricula.

**Freshman Engineering 102 is also required for undeclared students.

Curriculum Designated Requirements

Aerospace Engineering — Fr E 155L, Aer E 101
Agricultural Engineering — Chem 167L, Fr E 155L, Agron 154, A E 110
Ceramic Engineering — Chem 167L, sociohumanistic elective (3 cr.)
Chemical Engineering — Chem 177L, 178, 178L
Civil Engineering — Chem 167L, Com S 172
Computer Engineering — Com S 111, 112
Construction Engineering — Econ 201, Psych 101, Con E 100
Electrical Engineering — Com S 111, sociohumanistic elective (3 cr.).
Engineering Operations — Psych 101, I E 100
Engineering Science — Chem 167L, Com S 172, sociohumanistic elective (2 cr)
Industrial Engineering — Psych 101, I E 100
Mechanical Engineering — Chem 167L, Fr E 155L
Metallurgical Engineering — Chem 167L, MSE 101
Nuclear Engineering — Com S 172, sociohumanistic elective (3 cr.), Nuc E 100
Surveying — sociohumanistic elective (3 cr)

The student's adviser may require or recommend courses in addition to those specified above if the preparation and progress of the student are such that additional courses are necessary or desirable.

Requirement for Entry into Professional Program

Students enrolled in the College of Engineering must satisfy both of the following requirements before being admitted to a professional program:

1 Completion of the basic program with an average of 2 00 or better in the basic program

2 A cumulative grade average of 2 00 or better for all courses taken at Iowa State up to that time

Engineering undergraduates must be admitted to a professional program before they may enroll in 200-level or above courses offered in the College of Engineering. The only exceptions to the application of this rule are the following:

a. Students who completed all of their course work while enrolled in the College of Engineering, but have not been admitted to a professional program may enroll in 200-level or above courses offered in the College of Engineering for not more than one semester.

b. Students transferring to the College of Engineering from another school or another program outside this college who do not qualify for admission to a professional program may enroll in 200-level or above courses offered in the College of Engineering for not more than two semesters.

c. Iowa State students not pursuing an engineering degree may take engineering courses without restrictions provided they meet the prerequisites.

d. Only the first two semesters of 200-level and above engineering courses, taken while a student is not admitted to a professional engineering program, can be applied toward an engineering degree.

Students reentering the College of Engineering must have the approval of the College Academic Standards Committee

Advising System

The purpose of the advising system in the College of Engineering is to work constructively with students in developing their individual academic program and to maintain close contact with students during their college career.

The college also offers an orientation program during the summer for students planning to enter in the fall All prospective students are encouraged to attend a one-day orientation session. Tests given at this time help determine the student's level of achievement and enable the adviser to prepare an appropriate fall quarter program for the student

Special Programs

Engineering College students may participate in the following undergraduate programs. These programs are integrated into the professional engineering curricula and often require additional work. Each individual program is developed by the student and her/his engineering adviser.

a. **Cooperative Education Program** — The College of Engineering offers, through its curricula, cooperative programs in which students may gain practical experience in engineering during college years.

These programs are arranged so that the academic work is taught at the University and practical experience is gained by working in industry during certain periods each year. The student under a cooperative program receives experience in a chosen profession, plus financial return

The employer can evaluate the student's potential as a possible future permanent employee. The college gains by the engineering experiences which the cooperative student brings into the classroom

In general, students under these programs will require one year more to complete the usual curriculum requirements The first contact with industry usually comes after completion of the first or second year The college does not guarantee the kind of work or wages, but attempts to place students to their best educational and financial advantages.

A student must observe regulations of the employer and must not expect special treatment University holidays do not apply to cooperative students, nor are students allowed time off for University activities A student may not enroll in classes at any educational institution during a period of cooperative employment without University approval

Those in the cooperative program are considered by the University to be students while they are employed. Such students are subject to University regulations concerning conduct during this period and are liable to dismissal from the University for misconduct on the job. They may continue living in University housing during work periods

Cooperative students pay no fees to the University during work periods but may attend student activities provided they pay the activity fee.

b. **Engineering Journalism Program.** See *Index*, also see *Engineering Operations*.

c. **Environmental Studies Program.** See *Index*.

d. **Honors Program.** See *Index*.

e. **International Studies Program.** See *Index*, also see *Engineering Operations*.

f. **Officer Education Program.(ROTC).** See *Index*, also see *Engineering Operations*.

Curriculum in Aerospace Engineering

Leading to the degree Bachelor of Science
Total credits required: 133 5. See also *Basic Program* and *Cooperative Programs*

Professional Program

Sophomore Year

Cr.	Fall
4	Elementary Multivariable Calculus — Math 265
5	Introduction to Classical Physics II — Phys 222
3	Statics of Engineering — E M 274
3	Aerodynamics I — Aer E 241
3	Sociohumanistic elective*
18	

	Spring
4	Elementary Differential Equations and Laplace Transforms — Math 267
3	Mechanics of Materials — E M 324
3	Dynamics — E M 345
3	Aerodynamics II — Aer E 242
1	Aerospace Laboratory I — Aer E 271
3	Sociohumanistic elective*
17	

Junior Year

Cr.	Fall
3	Aerodynamic Theory I — Aer E 341
3	Astrodynamics I — Aer E 351
1	Aerospace Laboratory II — Aer E 371
4	Engineering Thermodynamics I — M E 331
3	Materials for Aerospace Applications — M S E 371
4	Introduction to Circuits, Instruments, and Electronics — E E 441
18	

	Spring
3	Aerodynamic Theory II — Aer E 342
3	Flight Structures Analysis — Aer E 321
3	Flight Vehicle Stability and Control — Aer E 355
2	Aerospace Laboratory III — Aer E 372
3	Mathematics elective****
3	Sociohumanistic elective*
R	Inspection Trip — Aer E 300
17	

Senior Year

Cr.	Fall
3	Aerospace Vehicle Propulsion I — Aer E 411
3	Advanced Flight Structures — Aer E 421
3	Flight Control Systems I — Aer E 431
3	Design and Analysis I — Aer E 461
1	Senior Projects — Aer E 471
R	Aerospace Seminar — Aer E 491
3	Sociohumanistic elective*
16	

Spring

3 Design and Analysis II — Aer E 462
1 Senior Projects — Aer E 472
3 Aerospace Technical Elective**
3 Technical Elective***
3 Physics Elective****
R Aerospace Seminar — Aer E 492
3 Sociohumanistic elective*

16

*The sociohumanistic electives are to be selected from the department-approved list of courses. Other courses may be applied upon prior approval by the student's adviser and the department head. Up to six credits of these electives taken at the 300 level or higher may be taken on a Pass-Not Pass basis.

**This aerospace technical elective is to be selected from the list of allowable aerospace technical elective courses.

***This technical elective may be selected from the list of aerospace technical electives or from 300-level or higher courses in any discipline, including advanced ROTC, which will be of value in meeting the student's career objectives and are approved by the student's adviser and the department head.

****The mathematics and physics electives must be selected from the department-approved lists of courses.

Curriulum in Agricultural Engineering

With options in electric power and processing, agricultural power and machinery, structures and environment, soil and water control, and food engineering. Administered jointly by the College of Agriculture and the College of Engineering

Leading to the degree Bachelor of Science. Total credits required: 130.5

See also *Basic Program* and *Cooperative Programs*.

Sophomore Year

Cr. Fall

4 Agricultural Engineering Concepts I — A E 201
3 Statics of Engineering — E M 274
4 Elementary Multivariable Calculus — Math 265
5 Introduction to Classical Physics II — Phys 222

16

Spring

4 Agricultural Engineering Concepts II — A E 202
3 Elementary Differential Equations — Math 266
3 Strength of Materials — E M 324
4 Principles of Economics — Econ 201
3 Fundamentals of Botany — Bot 307

17

Junior Year

Cr. Fall

4 Introduction to Circuits, Electronics and Instruments — E E 441
1 Mechanics of Materials Lab — E M 327
3 Thermodynamics — M E 330
6 Option or agricultural engineering electives**
3 Materials Engineering with Applications in A E — A E 359
R Seminar — A E 302

17

Spring

6 Option or agricultural engineering electives**
3 Mechanics of Fluids — E M 378
3 Fundamentals of Speech Communication — Sp 211
3 Sociohumanistic elective*
2 Introduction to Statistics — Stat 105

17

Senior Year

Cr. Fall

9 Option or agricultural engineering electives**
R Seminar — A E 401
3 American Government — Pol S 215
3 Sociohumanistic elective*

15

Spring

12 Option or agricultural engineering electives**
3 Sociohumanistic elective*

15

*Sociohumanistic sequences are to be chosen from the department-approved list.

**In the junior and senior years, each student elects one of the options and takes the courses listed for the selected option. In addition, each student must select a minimum of 8 credits of agricultural engineering electives from the other three options. At least one course must be selected in each of the other three options. This list of agricultural engineering electives includes: 342, 371, 421, 422, 443, 447, 463, 469, 471, 472.

Options:

Electric Power Processing — A E 463, 469; M E 336, 441, E M 345; 4 credits in E E selected with adviser, 5 credits of technical electives

Agricultural Power and Machinery — A E 342, 443, 444, 447, M E 310, 312, 321; E M 345, 417 or M E 322.

Structures and Environment — A E 371, 471, 472; C E 332, 334; M E 336, 441; E M 345; 2 credits of technical electives.

Soil and Water Control — A E 421, 422; C E 212, 332, 334, 360, 371; 3 credits of technical electives.

Curriculum in Ceramic Engineering

Administered by the Department of Materials Science and Engineering. Leading to the degree Bachelor of Science. Total credits required: 129.5. See also *Basic Program*.

Professional Program

Sophomore Year

Cr. Fall

5 Introduction to Ceramic Engineering — M S E 230
5 Introduction to Classical Physics II — Phys 222
4 Elementary Multivariable Calculus — Math 265
2 Computer Programming in FORTRAN — Com S 172

16

Spring

4 Introduction to Ceramic Science — M S E 231
3 Elementary Differential Equations — Math 266
3 Statics of Engineering — E M 274
3 Engineering Statistics — Stat 305
3 Sociohumanistic elective*

16

Junior Year

Cr. Fall

3 High Temperature Technology — M S E 330
3 Thermochemistry for Materials Science and Engineering — M S E 360
3 Electricity and electronics elective**
3 Mechanics of Materials — E M 324
4 Principles of Economics — Econ 201

16

Spring

4 Instruments for Materials Characterization — M S E 344
4 High Temperature Processes — M S E 345
3 Writing of Professional Papers and Reports — Engl 414
3 Electricity and electronics elective**
3 Sociohumanistic elective*
R Inspection Trip — M S E 340

17

Senior Year

Cr. Fall

3 Mechanical and Thermal Properties of Ceramic Materials — M S E 440
3 Refractories — M S E 441
3 Ceramic Engineering Design — M S E 445
3 Technical elective***
1 Mechanics of Materials Laboratory — E M 327
3 Free elective

16

Spring

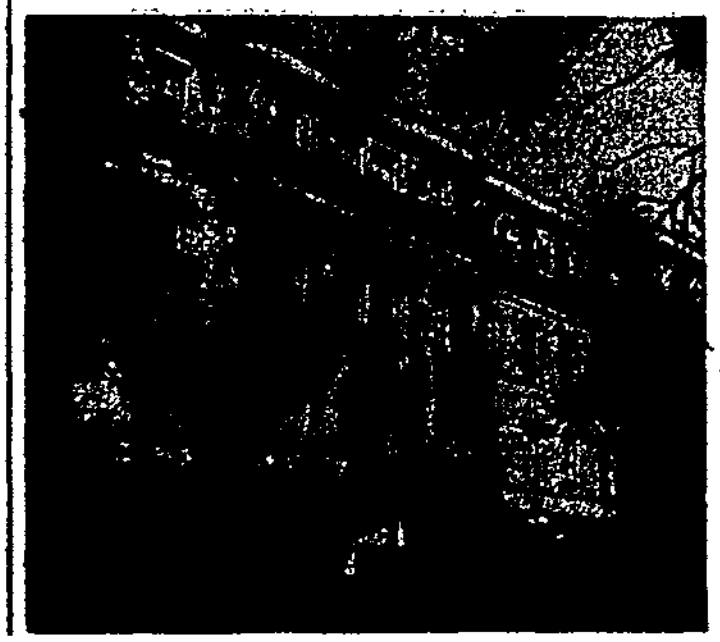
4 Vitreous State — M S E 442
2 Ceramic Engineering Design — M S E 446
3 Technical elective***
3 Electronic Ceramics — M S E 343
1 Application of Statistics to Materials — M S E 341
3 Free elective

16

*Sociohumanistic electives must be department approved.

**A minimum of 6 credits selected from E E 441, 445, 447, 449, Chem E 444, Cpr E 340, or 440.

***Technical electives must be department approved.



Curriculum in Chemical Engineering

Leading to the degree Bachelor of Science.
Total credits required: 129.5

See also *Basic Program* and *Cooperative Programs*.

Professional Program

Sophomore Year

Cr.	Fall
R	Seminar — Ch E 201
4	Material and Energy Balances — Ch E 210
4	Elementary Multivariable Calculus — Math 265
5	Introduction to Classical Physics II — Phys 222
2	Computer Programming in FORTRAN — Com S 172
15	

	Spring
R	Seminar — Ch E 202
3	Momentum Transport Operations — Ch E 320
1	Chemical Engineering Laboratory I — Ch E 324
4	Elementary Differential Equations and Laplace Transforms — Math 267
3	Physical Chemistry — Chem 321
4	Fundamentals of Mechanics — E M 301
15	

Junior Year

Cr.	Fall
R	Seminar — Ch E 301
3	Heat and Mass Transfer — Ch E 321
4	Chemical Engineering Thermodynamics — Ch E 331
3	Physical Chemistry — Chem 322
3	Organic Chemistry — Chem 331
3	Sociohumanistic elective*
16	

	Spring
R	Seminar — Ch E 302
4	Mass Transfer Operations — Ch E 322
1	Chemical Engineering Laboratory II — Ch E 325
3	Chemical Reactor Design — Ch E 332
3	Organic Chemistry — Chem 332
6	Sociohumanistic electives*
17	

Senior Year

Cr.	Fall
R	Seminar — Ch E 401
1	Chemical Engineering Laboratory III — Ch E 426
4	Process and Plant Design — Ch E 430
3	Chemical engineering elective**
3	Writing of Professional Papers and Reports — Engl 414
3	Sociohumanistic elective*
3	Elective
17	

	Spring
R	Seminar — Ch E 402
3	Process Control — Ch E 421
3	Chemical engineering elective**
4	Introduction to Circuits, Instruments and Electronics — E E 441
3	Sociohumanistic elective*
3	Elective
16	

*Selected from list of department approved courses.

**Selected from non-required chemical engineering courses that are open to undergraduates.

Curriculum in Civil Engineering

Leading to the degree Bachelor of Science.
Total credits required. 132 5

See also *Basic Program* and *Cooperative Programs*.

For those interested in construction engineering or surveying, curricula are provided which lead to the degree Bachelor of Science in construction engineering or the Bachelor of Science in surveying. For particulars, see *Curriculum in Construction Engineering* or *Curriculum in Surveying*.

Sophomore Year

Cr.	Fall
4	Elementary Multivariable Calculus — Math 265
5	Introduction to Classical Physics II — Phys 222
3	Fundamentals of Surveying — C E 212
3	Statics of Engineering — E M 274
2	Introduction to Statistics — Stat 105
1	The Practice of Engineering in Government — C E 295**
17-18	

	Spring
3	Elementary Differential Equations — Math 266
3	Advanced Engineering Surveying — C E 213
1	The Private Practice of Engineering — C E 296**
3	Mechanics of Materials — E M 324
1	Mechanics of Materials Laboratory — E M 327
2	Geology for Engineers — Geol 301
2	Analysis for Engineering Economy — I E 304
14-15	

Junior Year

Cr.	Fall
3	Structural Analysis I — C E 332
3	Mechanics of Fluids — E M 378
4	Soil Engineering — C E 360
3	Engineering Construction — C E 485
3	Sociohumanistic elective*
16	

	Spring
3	Structural Steel and Timber Design I — C E 333
3	Introduction to Transportation Engineering — C E 351
2	Design of Concretes and Pavements — C E 362
3	Engineering Hydrology — C E 371
3	Designated engineering science elective*
3	Sociohumanistic elective*
17	

Senior Year

Cr.	Fall
3	Reinforced Concrete Design I — C E 334
4	Municipal Water and Wastewater Engineering — C E 426
3	Highway Design — C E 452
8	Electives*
18	

	Spring
3	Construction or management elective*
15	Electives*
18	

*Shall be chosen from department-approved lists. Senior year electives shall include: (1) 9 credits of sociohumanistic studies, (2) 6 credits of engineering sciences which are to include courses in thermodynamics; heat, mass, and momentum transfer; electrical theory; materials; similitude; systems analysis, and mechanics; or one course in a life science, (3) 8 credits of technical electives. The construction or management electives must be selected in construction engineering, economics, psychology, business, and/or industrial engineering. Students appointed to advanced ROTC may substitute 4 credits of advanced ROTC for 4 credits of technical electives.

**C E 295 or 296 required, but not both.

Curriculum in Computer Engineering

Administered by the Department of Electrical Engineering

Leading to the degree Bachelor of Science
Total credits required. 130.5

See also *Basic Program* and *Cooperative Programs*

Sophomore Year

Cr.	Fall
3	Introduction to Digital Techniques — Cpr E 280
3	Electric Circuits I — E E 205
2	Electrical Instrumentation and Experimentation — E E 235
4	Elementary Multivariable Calculus — Math 265
5	Introduction to Classical Physics II — Phys 222
17	

Spring

2	Digital Laboratory I — Cpr E 287
4	Electronics I — E E 330
3	Machine Organization and Assembly Language Programming — Com S 221
4	Elementary Differential Equations and Laplace Transforms — Math 267
3	Sociohumanistic elective*
16	

Junior Year

Cr.	Fall
3	Computer Organization and Design I — Cpr E 384
3	Elementary Electromagnetics I — E E 212
3	File Organization and Processing — Com S 211
4	Fundamentals of Mechanics — E M 301
3	Sociohumanistic elective*
16	

Spring

3	Computer Organization and Design II — Cpr E 385
2	Digital Laboratory II — Cpr E 387
3	Introduction to Operating Systems — Com S 352
3	Digital Integrated Circuits — E E 437
3	Sociohumanistic elective*
14	

Senior Year

Cr.	Fall
10	Technical electives**
3	Elective***
3	Sociohumanistic elective*
16	

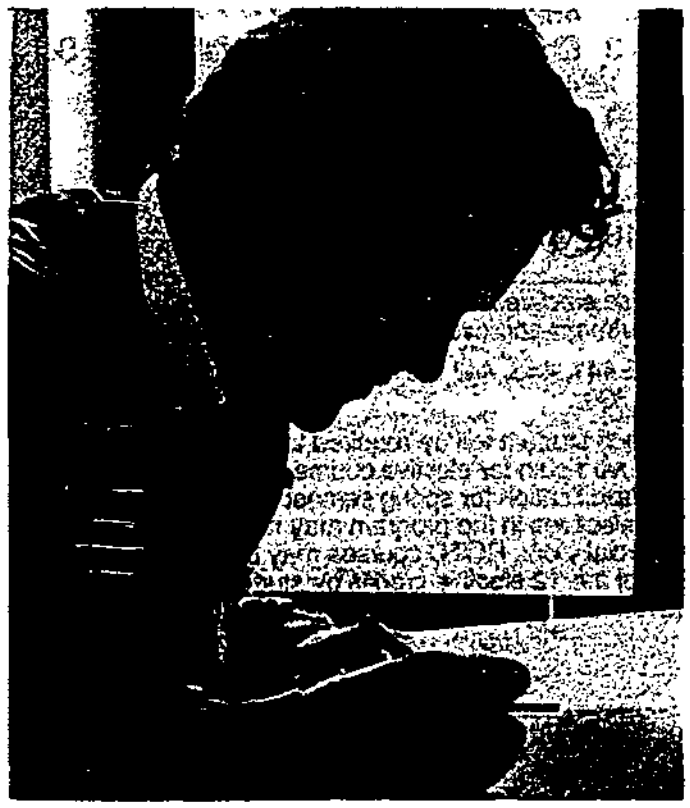
Spring

8	Technical electives**
3	Elective***
6	Sociohumanistic electives*
17	

*Sociohumanistic electives must be chosen from a list of sequences approved by the department.

**Technical electives are of three types: (1) mathematics and statistics, (2) computer engineering, computer science and electrical engineering, and (3) other engineering and science courses. All technical electives must be chosen from lists of courses approved by the department. At least one course must be chosen from the mathematics and statistics list. The distribution of the remaining courses must comply with departmental rules.

***The only restriction on these electives is that they cannot be remedial.



Curriculum in Construction Engineering

Administered by the Department of Civil Engineering.

Leading to the degree Bachelor of Science. Total credits required: 131 (132 in heavy construction, 133 in mechanical construction)

See also *Basic Program* and *Cooperative Programs*

Sophomore Year

Cr.	Fall
2	Computer Programming in FORTRAN — Com S 172
3	Analysis of Construction Materials and Methods — Con E 241
3	Principles of Accounting I — Acct 284
4	Elementary Multivariable Calculus — Math 265
5	Introduction to Classical Physics II — Phys 222
17	

Spring

3	Construction Contract Documents and Administration — Con E 245
3	Statics of Engineering — E M 274
3	Fundamentals of Speech Communication — Sp 211
2	Introduction to Statistics — Stat 105
4-5	Professional electives*
15-16	

Junior Year

Cr.	Fall
3	Construction Estimating and Cost Control — Con E 346
3	Mechanics of Materials — E M 324
2	Analysis for Engineering Economy — I E 304
3	Engineering Contracts — I E 480
7	Professional electives*
18	

Spring

3	Construction Organization and Management — Con E 371
3	Engineering Materials — E M 337
3	Technical elective**
5-7	Professional electives*
14-16	

Senior Year

Cr.	Fall
0.5	Professional Development — Con E 400
3	Business-management elective**
3	Sociohumanistic elective**
8-9	Professional electives*
14.5-15.5	

Spring

3	Construction Planning, Scheduling and Control — Con E 441
3	Business Communication — Engl 302
3	Sociohumanistic elective**
5-7	Professional electives*
14-16	

*Courses for professional elective credits are designated by the following course groupings in accordance with the construction emphasis chosen by the student. Building construction — C E 215, 332, 333, 334, 360; Con E 372, 440; E E 449; E M 378; Geol 301; M E 440. Heavy construction — C E 212, 213, 332, 333, 334, 360, 362, 460; Con E 372, 440; Geol 301; technical elective, 2 cr. min.** Mechanical construction — C E 215, 336; E E 441, 447; E M 345, 378; Math 266; M E 331, 336 or 436, 441, 442.

**Shall be chosen from curriculum-approved lists of electives in subject areas. Up to four credits of air force aerospace studies or military science course work, 300-level and above, may be applied as business management electives as applicable. Up to four credits of naval science course work, 300-level and above, may be applied as technical or business management electives as applicable.

Curriculum in Electrical Engineering

Leading to the degree bachelor of science. Total credits required: 133.5.

See also *Basic Program* and *Cooperative Programs*.

Sophomore Year

Cr.	Fall
1	Language Proficiency Laboratory — Com S 200
3	Electric Circuits I — E E 205
2	Electrical Instrumentation and Experimentation — E E 235
4	Elementary Multivariable Calculus — Math 265
5	Introduction to Classical Physics II — Phys 222
3	Sociohumanistic elective*
18	

Spring

3	Introduction to Digital Techniques — Cpr E 280
3	Electric Circuits II — E E 206
3	Elementary Electromagnetics I — E E 212
4	Electronics I — E E 330
4	Elementary Differential Equations and Laplace Transforms — Math 267
17	

Junior Year

Cr.	Fall
4	Elementary Electromagnetics II — E E 313
4	Electronics II — E E 331
4	Fundamentals of Mechanics — E M 301
3	Introduction to Partial Differential Equations — Math 385
3	Sociohumanistic elective*
18	

Spring

3	Electric Network Design — E E 309
4	Electromagnetic Devices and Electric Machinery — E E 351
1	Electromagnetic Devices and Electric Machinery Laboratory — E E 352
3	Linear Systems Analysis — E E 474
3	Numerical Solution of Differential Equations and Interpolation — Math 481
3	Sociohumanistic elective*
17	

Senior Year

Cr.	Fall
3	Elementary Modern Physics — Phys 324
9	Technical electives**
3	Sociohumanistic elective*
15	

Spring
3 Elementary Solid State Physics — Phys 325
8 Technical electives**
3 Sociohumanistic elective*
14

*Sociohumanistic electives must be chosen from a list of sequences approved by the department.

**Technical electives are of two types: (1) courses in computer engineering and electrical engineering, and (2) other courses in engineering and science. All technical electives must be chosen from lists approved by the department. The distribution of courses between the two types must comply with departmental rules.

Curriculum in Engineering Operations

Administered by the Department of Industrial Engineering.

Leading to the degree Bachelor of Science Total credits required: 120.5 .See also *Cooperative Program.*

In this era of rapid technological change, there is an expanding and continually accelerating need for persons with an engineering background. The need for people with a strong technological base to fill positions requiring managerial and supervisory requirements is ever-increasing in industry and government. Engineering operations is specifically designed to develop this background within several engineering disciplines, or in combination with engineering and other disciplines.

The curriculum consists of a basic core of required courses in the sciences, engineering, and management to which are added 61 credits of elective courses in the specific categories of engineering, sociohumanistics, management, and preliminary supporting subjects. Within this framework, students may specialize toward specific occupational objectives of their choice Many students choose to work toward the specializations indicated below.

Prior to entering the engineering operations program the student must have completed the basic program and have presented a description of the vocational objective to be achieved through the program to the department chairman for approval. In addition the student will submit a schedule of courses to support this objective.

Specializations

Biomedical — Provides the background for study in biomedical engineering.

Economy and Valuation — Study of the value of property and related economic analyses in the management of capital invested in plant and equipment.

Manufacturing Psses — Emphasis on production considerations in selection and specification of manufacturing equipment. Functional characteristics related to production.

Operations Research — Development of mathematical concepts and models concerned with decision making in engineering and management.

Prelaw — Preparation for study in corporate or patent law.

Premedical — Provides background for study in human medicine.

Technical Sales — Provides a background for selling products of a technical nature and solving engineering problems which may arise following such sales.

Special Programs

To meet special needs, programs are available in the following (see *Index).*
Program in International Studies.
Program in Engineering Journalism
Program in Engineering for Officer Education

Required Courses

Cr. **Basic sciences**
12 Math 165, 166, 265
4 Chem 167
10 Phys 221, 222
26 Total

Sociohumanistic courses
3 Psych 101
4 Econ 201
7 Total

Communication skills
3 Fr E 165
6 Engl 104, 105
6 Sp 211, Engl 414
15 Total

Miscellaneous
2 5 Fr E 155, Lib 160
3 I E 480 or Mgmt 315
4 Com S 172, Acct 381
2 I E 250
R Fr E 101
R I E 393
R E Op 291
11.5 Total

Group Requirements

Course combinations for each student should be integrated toward a vocational objective. Each student's choice of courses in the following groups must be approved in advance by the head of the Department of Industrial Engineering

Cr.
12 **Engineering science:** engineering mechanics, 6; electrical engineering, 4, measurements, 2
18 **Engineering Analysis** (300 level or above)
11 **Supporting work** (basic and engineering sciences)
10 **Management, production, business or sales courses** (300 level or above, principally in business administration or industrial engineering)
10 **Sociohumanistic sequences**

Curriculum in Engineering Science

Administered by the Department of Engineering Science and Mechanics.

Leading to the degree Bachelor of Science. Total credits required: 133.5.

See also *Basic Program* and *Cooperative Programs.*

Sophomore Year

Cr. Fall
4 Elementary Multivariable Calculus — Math 265
5 Introduction to Classical Physics II — Phys 222
2 Introduction to Statistics — Stat 105
3 Statics of Engineering — E M 274
3 Electric Circuits I — E E 205**
17

Spring
4 Elementary Differential Equations and Laplace Transforms — Math 267
3 Basic Engineering Design I — E Sci 280
3 Mechanics of Materials — E M 324
1 Mechanics of Materials Laboratory — E M 327
2 Electrical Instrumentation and Experimentation — E E 235**
3 Sociohumanistic elective*
16

Junior Year

Cr. Fall
3 Introduction to Partial Differential Equations — Math 385
4 Engineering Materials — E Sci 351
3 Dynamics — E M 345
4 Electronics I — E E 330**
3 Sociohumanistic elective*
17

Spring
4 Engineering Materials — E Sci 352
3 Basic Engineering Design II — E Sci 380
3 Mechanics of Fluids — E M 378
4 Engineering Thermodynamics I — M E 331
3 Elective***
17

Senior Year

Cr. Fall
3 Advanced Analysis and Design — E Sci 481
3 Mechanical Vibrations — E M 444
3 Elements of Heat Transfer — M E 436
3 Writing of Professional Papers and Reports — Engl 414
R Seminar — E Sci 401
3 Elective***
2 Sociohumanistic elective*
17

Spring
3 Advanced Analysis and Desgin — E Sci 482
3 Energy Sources and Utilization — E Sci 412
R Seminar — E Sci 402
6 Electives***
4 Sociohumanistic elective*
16

*These electives are to be chosen from the department-approved list of sociohumanistic sequences.

**E E 441, 445, 447 may be substituted for E E 205, 235, 330.

***Each student will be required to have on file an approved plan for elective courses before preclassification for spring semester of the junior year. The electives in the program may not be used for remedial work. ROTC courses may be used to satisfy any of the 12 elective credits by students admitted to advanced ROTC.

Curriculum in Industrial Engineering

Leading to the degree Bachelor of Science. Total credits required: 129.5.

See also *Basic Program* and *Cooperative Programs*.

Sophomore Year

Cr.	Fall
4	Elementary Multivariable Calculus — Math 265
5	Introduction to Classical Physics II — Phys 222
3	Fundamentals of Speech Communication — Sp 211
2	Computer Programming in FORTRAN — Com S 172
2	Introduction to Industrial Engineering — I E 250
16	

	Spring
3	Elementary Multivariable Calculus — Math 266
4	Principles of Economics — Econ 201
4	Probability and Statistical Inference for Engineers — Stat 231
2	Industrial Accounting — Acct 381
3	Industrial Computer Techniques — I E 209
R	Seminar — I E 293
16	

Junior Year

Cr.	Fall
3	Materials Science and Engineering — M S E 271
3	Engineering mechanics elective*
2	Ergonomics in Work System Design — I E 274
4	Industrial Operations Research — I E 312
3	Methods Engineering and Work Measurement — I E 373
15	

	Spring
3	Industrial Quality Control and Inspection — I E 361
2	Industrial Methodology — I E 374
3	Engineering Economy — I E 404
2	Human Resource Management — I E 424
4	Electrical engineering elective*
3	Engineering mechanics elective*
R	Industrial Inspection Trip — I E 393
17	

Senior Year

Cr.	Fall
5	Industrial Engineering Design — I E 441
3	Material and Project Control — I E 341
3	Thermodynamics — M E 330
6	Industrial engineering electives*
R	Professional Development — I E 491
17	

	Spring
3	Writing of Professional Papers and Reports — Engl 414
2	Industrial engineering elective*
6	Engineering science electives*
6	Sociohumanistic electives*
17	

*These electives are to be chosen from department authorized lists with advanced approval.

Curriculum in Mechanical Engineering

Leading to the degree Bachelor of Science. Total credits required: 127.5. See also *Basic Program* and *Cooperative Programs*.

Sophomore Year

Cr.	Fall
4	Elementary Multivariable Calculus — Math 265
5	Introduction to Classical Physics II — Phys 222
1	Laboratory Survey of Classical Physics — Phys 224
3	Statics of Engineering — E M 274
2	Introduction to Principles of Macro-Economics — Econ 203
15	

	Spring
4	Elementary Differential Equations and Laplace Transforms — Math 267
3	Dynamics — E M 345
3	Mechanics of Materials — E M 324
2	Principles of Materials Science — M S E 270
3	Introduction to Mechanical Engineering — M E 253
R	Industrial Inspection — M E 201
15	

Junior Year

Cr.	Fall
3	Mechanisms — M E 310
3	Mechanical Behavior of Materials — M E 321
4	Engineering Thermodynamics I — M E 331
4	Introduction to Circuits, Instruments and Electronics — E E 441
3	Sociohumanistic elective*
17	

	Spring
3	Mechanical Systems — M E 311
3	Manufacturing Processes — M E 322
3	Engineering Thermodynamics II — M E 332
3	Fluid Flow — M E 335
2	Introduction to Electric Machinery — E E 447
3	Sociohumanistic elective*
R	Mechanical Engineering Seminar — M E 301
17	

Senior Year

Cr.	Fall
3	Design of Machine Elements — M E 312
3	Engineering Measurements and Instrumentation — M E 360
3	Heat Transfer — M E 436
2	Sociohumanistic elective *
6	Technical electives**
17	

	Spring
3	Design elective***
1	Experimental Engineering — M E 460
9	Technical electives **
3	Sociohumanistic elective*
16	

*Sociohumanistic elective courses are to include 6 credits in the humanities.

**Technical electives are to include at least 9 credits of mechanical engineering courses from 400- and 500-level offerings. Additional electives may be chosen from the offerings of other engineering departments, mathematics, physical sciences, and biological sciences at the 500-level or as listed under "open to graduate students for minor credit only" declarations of the departments, with one prerequisite course allowed which is not on the list. Suggested areas of specialization are the following:
Energy conversion and utilization — M E 422, 446, 447, 448, 449; Acct 381; E E 456, 457; I E 404.
Machines and systems — M E 411, 412, 414, 415, 470, 490F, 514, 515, 516, 518, 535; E M 484, 514, 515, 517, 519, 525, 544.
Materials and Manufacturing — M E 411, 490G, 515, 520, 521, 526, 528; E M 514, 544; M S E 401, 402, 522, 524; I E 475.
Thermal and environmental engineering — M E 441, 442, 444, 445, 446, 447, 475, 490D, 490J, 490K, 530, 531, 532, 533, 536, 540, 541, 542, 545, 546, 547, 548, 561, 571, 573 and applicable courses in other departments.
Propulsion — M E 445, 447, 448, 449, 490J, 490K, 490L, 542, 545, 548; Aer E 411.

***The design elective must be chosen from M E 415, 442, 446, or 449.

Curriculum in Metallurgical Engineering

Administered by the Department of Materials Science and Engineering. Leading to the degree Bachelor of Science. Total credits required: 127.5. See also *Basic Program*.

Professional Program

Sophomore Year

Cr.	Fall
2	Principles of Materials Science — M S E 270
2	Introductory Physical Metallurgy Lab — M S E 270L
5	Introduction to Classical Physics II — Phys 222
4	Elementary Multivariable Calculus — Math 265
3	Statics of Engineering — E M 274
16	

	Spring
3	Introduction to Metallurgical Engineering — M S E 203
3	Elementary Differential Equations — Math 266
3	Mechanics of Materials — E M 324
3	Sociohumanistic elective
4	Free elective
16	

Junior Year

Cr.	Fall
3	Thermochemistry for Materials Science and Engineering — M S E 360
4	Physical Metallurgy — M S E 301
2	Metallography Laboratory — M S E 301L
3	Electricity and electronics elective*
4	Sociohumanistic elective
16	

Spring
4 Principles of Extractive Metallurgy — M S E 361
4 Physical Metallurgy — M S E 302
2 Physical Metallurgy Laboratory — M S E 302L
3 Mechanical Metallurgy — M S E 401
3 Sociohumanistic elective
16

Senior Year

Cr. Fall
3 Mechanical Metallurgy — M S E 402
2 Mechanical Metallurgy Laboratory — M S E 402L
1 Metallurgy Seminar — M S E 400
3 Sociohumanistic elective
7 Technical electives**
16

Spring
3 Metallurgical Engineering Design — M S E 421
3 Sociohumanistic elective
7 Technical electives
4 Free elective***
17

*Selected from a list of department-approved courses.

**Must include 8 credits of additional materials science and engineering courses and 3 credits in written or spoken English beyond 105.

***Six credits of advanced ROTC can be taken as free electives. A maximum of 3 credits of physical education can be taken as free electives.

Curriculum in Nuclear Engineering

Leading to the degree Bachelor of Science
Total credits required: 130 5

See also *Basic Program* and *Cooperative Programs*.

Sophomore Year

Cr. Fall
4 Elementary Multivariable Calculus — Math 265
5 Introduction to Classical Physics II — Phys 222
3 Fundamentals of Nuclear Engineering — Nuc E 211
4 Principles of Economics — Econ 201
16

Spring
4 Elementary Differential Equations and Laplace Transforms — Math 267
3 Materials Science and Engineering — M S E 271
3 Radiation and Radioactivity — Nuc E 221
4 Fundamentals of Mechanics — E M 301
3 Fundamentals of Speech Communication — Sp 211
17

Junior Year

Cr. Fall
4 Fission Reactor Analysis — Nuc E 331
1 Laboratory in Reactor Analysis — Nuc E 331L
3 Nuclear Materials and Radiation Effects — M S E 375
4 Engineering Thermodynamics I — M E 331
2 Analysis for Engineering Economy — I E 304
3 Sociohumanistic elective*
17

Spring
3 Nuclear Engineering Laboratory — Nuc E 361
3 Mechanics of Fluids — E M 378
4 Introduction to Circuits, Instruments and Electronics — E E 441
3 Free elective
3 Sociohumanistic elective*
16

Senior Year

Cr. Fall
3 Nuclear Fuel Cycles, Processes, and Management — Nuc E 451
3 Nuclear Power System Analysis and Design I — Nuc E 481
R Seminar — Nuc E 491
3 Heat Transfer — M E 436
3 Writing of Professional Papers and Reports — Engl 414
3 Business management elective**
15

Spring
3 Safety and Control of Nuclear Systems — Nuc E 441
3 Nuclear Power System Analysis and Design II — Nuc E 482
R Seminar — Nuc E 492
1 Nuclear Systems Laboratory — Nuc E 461
3 Free elective
3 Technical elective***
3 Sociohumanistic elective*
16

*These electives are to be chosen from the department-approved list of sociohumanistic courses.

**This elective is to be chosen from the department-approved list of business management courses.

***This elective is to be chosen from the department-approved list of technical courses.

Curriculum in Surveying

Administered by the Department of Civil Engineering

Leading to the degree Bachelor of Science
Total credits required: 130 5

See also *Basic Program* and *Cooperative Programs*

Sophomore Year

Cr. Fall
3 Fundamentals of Surveying — C E 212
3 Cartography — C E 301
5 Introduction to Classical Physics II — Phys 222
4 Fundamentals of Mechanics — E M 301
2 Introduction to Statistics — Stat 105
17

Spring
3 Advanced Engineering Surveying — C E 213
1 Mechanics of Materials Laboratory — E M 327
3 Mechanics of Fluids — E M 378
4 Elementary Multivariable Calculus — Math 265
2 Computer Programming in FORTRAN — Com S 172
4 Sociohumanistic elective*
17

Junior Year

Cr. Fall
2 Geodetic Control Systems — C E 315
3 Engineering Hydrology — C E 371
2 Geology for Engineers — Geol 301
3 Theory of Matrices — Math 307
2 Analysis for Engineering Economy — I E 304
4 Elective**
16

Spring
2 General Photogrammetry and Photointerpretation — C E 414
2 Land Surveying — C E 317
3 Computer Graphics — I E 333
3 Landforms — Geol 377
3 Planning Analysis and Techniques — C R P 272
3 Elective**
16

Senior Year

Fall
3 Subdivision Design and Layout — C E 417
3 Stereo-Photogrammetry — C E 418
4 Independent Study (Senior Project) — C E 490
3 Principles and Techniques of Remote Sensing — C E 419
4 Electives**
17

Spring
2 Survey Computation and Design — C E 412
2 Independent Study (Senior Project) — C E 490
3 Writing of Professional Reports and Papers — Engl 414
9 Electives**
16

*Should be chosen from a curriculum-approved list of sociohumanistic electives.

**These electives shall include (1) 9 credits of sociohumanistic electives from a curriculum-approved list as above, and (2) 11 credits from a curriculum-approved list of technical and management electives.

College of Home Economics

Ruth E Deacon, Dean
Helen LeB Hilton, Emeritus Dean
Julia F Anderson, Associate Dean — Administration
Mary E. Heltsley, Assistant Dean — Research
Elizabeth A Elliott, Associate Dean — Extension
Jeannette M Korslund, Assistant to the Dean

Departments of the College

Child Development
Family Environment
Food and Nutrition
Home Economics Education
Home Economics Studies
Institution Management
Textiles and Clothing

Curricula in Home Economics

The curricula are planned to meet a variety of academic interests, abilities, and goals of the student Each curriculum requires depth in a discipline Breadth is acquired through general education and careful use of electives.

Adult Home Economics Education
Apparel Design and Patternmaking
Child, Parent, and Community Services
Community Nutrition — Food and Nutrition
Dietetics — Food and Nutrition
Family Resource Management
Family Services
Fashion Merchandising
Food Science — Food and Nutrition
Foodservice Management
General Studies in Home Economics
Growth and Development of Children
Home Economics Education
Home Economics Journalism
Hotel and Restaurant Management
Housing and the Near Environment
International Studies in Home Economics
Nutritional Science — Food and Nutrition
Teaching Prekindergarten-Kindergarten Children
Textiles and Clothing Related Science

Open Option Status

The College of Home Economics offers an open option for entering students who have not selected a specific area of study. A one-credit orientation course, Home Economics 101, Introduction to Home Economics, is available to assist students explore the opportunities available. Program planning information can be obtained from academic advisers in the Department of Home Economics Studies.

Special Interest Programs

Related Art and Home Economics

Programs with related art emphases are available in the College of Home Economics

Students interested in housing and interior furnishings could develop a program in Housing and the Near Environment or General Studies.

Cross Cultural Programs

Available in the Department of Home Economics Studies

Home Economics Extension

Students may prepare for a career in the Cooperative Extension Service by enrolling in any of the home economics curricula which provide them with a broad subject matter base for conducting educational programs for families. Courses should include Psych 333, H Ed 410, 413 and Ad Ed 469. Advice on choice of additional courses should be sought from the associate dean and state leader of home economics extension programs, the state 4-H and youth leader, or the coordinator of extension personnel training.

Home Economics Rehabilitation Emphasis

Programs with an emphasis in rehabilitation are available in the departments of Child Development, Family Environment, Food and Nutrition, and Home Economics Education Supporting courses are available from the Textiles and Clothing Department. These programs combine coursework with a practicum experience Graduates are prepared for employment with public and private agencies serving the handicapped

Honors Program

Superior students are encouraged to develop individualized programs of study consistent with educational objectives Honors students participate in an honors project within the major area of study and are expected to maintain a grade point average above 3.35. For further information contact the College Honors Committee, academic adviser, or see Index, *Honors Program.*

Recommended Preparation

Students will find it beneficial to have a high school background of at least 3 semesters of algebra, 1 year of chemistry, 1 year of biological science, and 4 years of English composition and rhetoric

Advising System

Each student in the College of Home Economics has an academic adviser. Faculty members in the Department of Home Economics Studies advise all freshmen. Upperclass students are assigned faculty advisers in the departments of their chosen curriculum. Advisers assist students in making adjustments to the University and provide information and guidance on vocational choices. Assistance is given the students in scheduling course work in accordance with their interests and capabilities

Planned Transfer Programs

The College of Home Economics has a specific program with Central College. By careful planning a student may take two years at Central College and two years at Iowa State University and complete degree requirements in four years in any of the curricula. Applications for admission to the transfer program in home economics should be addressed to the Director of Admissions, Central College.

In addition, most community colleges have planned transfer programs with the College of Home Economics. Contact the Director of Admissions at these institutions for further information

Prospective transfer students are urged to contact the College of Home Economics or the department of major interest regarding selection of appropriate courses transferable toward graduation. Selection of specific curricula may be delayed one semester following enrollment Special orientation sessions are available for transfer students

Preparation for Graduate Study

Students consideraing graduate school should gain background knowlege in basic subjects related to their area of interest. Undergraduate mathematics, statistics, and research methods courses are useful as preparation for advanced study in graduate school. Upon completion of graduate programs, students are qualifed for responsible research positions in public and private institutions and for appointments that may involve teaching, research, and extension in colleges and universities.

Professional Opportunities in Home Economics

Placement of graduates remains at a high level They are employed in education, business and industry, and by nonprofit and government organizations. Graduates may teach preschool and kindergarten children and/or preschool handicapped children, or teach home economics in public schools and through the extension service. Examples of opportunities in business and industry include: housing and furnishings consultant; management trainee; merchandising trainee; test laboratory home economist — food, textiles, equipment; writer; sales representative; and consumer product specialist. Health, social service, recreation organizations, and government agencies employ dietitians and other specialists for child, family, and consumer services. Usually the graduate's strength is in interpreting the products or services of the organization to families and consumers and in representing the interests of families and consumers within the organization. Students may plan a program to prepare for professional programs such as medicine or law while pursuing a B.S. degree.

General Education
Each department within the college requires students to select and/or elect courses to fulfill a specific number of credits in prescribed areas.

Group Requirements in the College of Home Economics

Cr.	
5	I Home economics[a]
9	II Natural sciences and mathematical disciplines
9	III Social sciences
9	IV Humanities
8	V Communications
0.5	VI Library instruction

[a]Assumes additional credits will be necessary for meeting the objectives of the College of Home Economics, including the areas of nutrition, management, and educational principles.

Curriculum in Adult Home Economics Education

Leading to the degree Bachelor of Science. Total credits required: 128.5.

This curriculum is designed for students interested in preparing for a variety of adult education programs in extension, area schools, and business.

Cr.	
42-46	**Degree Requirements**
30	**Home Economics** C D 224; C D/F E 201; F E 240, 378, 488; F N 107, 208; HE St 101, 401; T C 121, 204
3	Select from C D 225, 226
3	Select from F E 354; HE St 210
3	Select from I Mgt 380 and 380L; F N 303
2-3	Select from T C 165, 245
2-4	Select from F E 370 and 370L, 415; HE St 420
20	**Professional Courses** H Ed 206, 408, 410, 411, 418, 420, 508; Psych 333; SecEd 301
39.5	**General Education**
9	**Communications:** Engl 104, 105; Sp 211
12-13	**Art and Humanities*:** Select from two areas: foreign language, history, literature, music, philosophy; select 3-4 from Art 101 and 102, 261
0.5	**Library Instruction:** Lib 160
11	**Natural sciences and mathematical disciplines:** Biol 109 or Zool 155; Chem 163, 163L, 231
10	**Social sciences:** Econ 201; Psych 230; Soc 134
1	**Dance, health, physical education**
20-22	**Electives**
128.5	**Total credits**

*A list of approved courses may be obtained in departmental office.

Curriculum in Apparel Design and Patternmaking

Administered by the Department of Textiles and Clothing, leading to the degree Bachelor of Science. Total credits required: 128.5.

The curriculum in apparel design and pattemmaking is planned for those interested in the aesthetic aspects of textiles and clothing and in apparel designing.

Cr.	Degree Requirements
27	**Textiles and clothing/home economics** T C 121, 165, 204, 245, 275, 480; Art 101, 102; C D / F E 201; F N 107; HE St 101, 401
37-40	**Professional courses**
20-21	T C 222, 323, 304 or 404, 345, 354, 355, 431
3	Select from T C 375, 464, 465, 468
9	T C 278, 279; Dsn S 140
5-7	Select from one of the following groups: Art 243, 244, 247, 261, 346; HE St 210 or Art 203, 300, 350; HE St 330 or Sp 106, 250, 255, 356
	General Education
13-15	**Communications**
8-9	Engl 104, 105; Sp 211 or 212
3	Select from Engl 302; Sp 151, 311, 312
2-3	Select from Jl MC 225, 325; Psych 250
9	**Humanities:** Art 280, 281; Hist 201
0.5	**Library instruction:** Lib 160
11	**Natural sciences and mathematical disciplines**
3	Select from Biol 109, 110; Zool 155
5	Chem 163, 163L
3	Select from Math 104, 140, 150
10	**Social sciences:** Econ 201; Psych 101; Soc 134
16-21	**Electives**
128.5	**Total credits**

Curriculum in Child, Parent, and Community Services

Administered by the Department of Child Development, leading to the degree Bachelor of Science. Total credits required: 128.5.

The child, parent and community services curriculum in the Department of Child Development is a choice for those students who prefer to become employed in broadly defined community programs for children rather than to specialize in a teaching or a research career. Service opportunities for graduates of this curriculum include positions with 4-H and Youth Services, Cooperative Extension, Social Services, community hospitals, community Home Start programs, recreation programs for children and club organizations such as Girl Scouts of America. Considerable elective credit available in this curriculum provides opportunity to students for planning programs of study suited to their individual interests.

Cr.	Degree Requirements
36.5	**Child development/home economics**
30.5	C D 129, C D / F E 201, C D 240, 318, 341, 342, 369, 445, 449, F N 107, HE St 101, 401
6	Select from C D 224, 225, 226
26-28	**Professional courses**
1	El Ed 301
2-3	Select from Jl MC 225, 450, Engl 302
3	Select from Soc 264, Sp 317, F E 370
3	Select from F E 185, 378, Anthr 313, Soc 485
3	Select from Soc 415, 420, 464, Ad Ed 469
2-3	Select from Soc 300, 331, 410, El Ed 406
12	C D 417B, 418
8	**Communications** Engl 104, 105, Sp 212
9	**Humanities** Select from art history, foreign language, history, literature, music appreciation, philosophy, religion
0.5	**Library instruction** Lib 160
9	**Natural sciences and mathematical disciplines**
3	Zool 155
3	Select from physical sciences, statistics, mathematics
3	Select from biological or physical sciences, statistics, mathematics
9	**Social sciences**
3	Select from American history or American government
3	Anthr 111
3	Soc 134
2.5	**Health, dance, and physical education**
2	H S 105
0.5	Select from physical education or dance activity courses
26-28	**Electives**
128.5	**Total credits**

Curriculum in Community Nutrition — Food and Nutrition

Leading to the degree Bachelor of Science Total credits required: 128.5.

This curriculum provides basic preparation for students who desire employment with nutrition services of public health departments, social welfare agencies, commercial organizations, or extension. It meets academic requirements for admission to those dietetic internships which offer a specialization in community nutrition

Cr.	Degree Requirements
34	**Food and nutrition** F N 107, 214, 303, 305, 305L, 404, 410, 411, 413, 414, 431
10-11	**Communications** Engl 104, 105; Sp 212; select from Engl 302, 414, or Jl MC 225
12	**Home economics** C D/F E 201; HE St 101, 401; I Mgt 380, 380L, 438
9	**Humanities** Select from foreign languages, history, literature, music, philosophy
0.5	**Library instruction** Lib 160
31-32	**Natural sciences and mathematical disciplines** B B 301, 311; Biol 110, 110L; Chem 163, 163L, 231, 232B; Micro 300; Stat 101 or 104; Zool 155, 156.

Cr.	Degree Requirements
19	Social sciences Econ 201; Pol S 215; Psych 101 or 230, 313 or 333, Soc 134, 264
11-13	Electives
128.5	Total credits

Curriculum in Dietetics — Food and Nutrition

Leading to the degree Bachelor of Science
Total credits required: 128.5.

This curriculum serves the interests of the student who wishes to be prepared to work in the medical aspects of nutrition, including nutrition education, and in food service systems Two options are available to the student wishing to major in dietetics.

I. Option in General and Clinical Dietetics
The student is prepared for admission to hospital and other dietetic internship programs. Courses included meet academic requirements of the American Dietetic Association for internships with a specialization in general and clinical dietetics

Cr.	Degree Requirements
30-31	Food and nutrition F N 107, 214, 303, 305, 305L, 404, 410, 411, 418, 430, 431
10-11	Communications Engl 104, 105; Sp 212, select from Jl MC 225 or 3 credits of written English
18	Home economics C D/F E 201, HE St 101, 401, I Mgt 380, 380L, 434, 435, 438
9	Humanities Select 3 credits from history, 6 credits from foreign languages, history, literature, music, philosophy
0.5	Library instruction Lib 160
34-36	Natural sciences and mathematical disciplines B B 301, 311, Biol 110, 110L; Chem 163, 163L, 231, 232B; Micro 300; Stat 104; Zool 155, 156; select from Gen 260, Zool 206 and 206L, or Zool 355
1.5	Physical education
13	Social sciences Econ 201, Psych 101 or 230, 313 or 333; Soc 134
8.5-12.5	Electives
128.5	Total credits

II. Option in Coordinated Undergraduate Program
This option is offered jointly by the departments of Food and Nutrition and Institution Management. The coordinated undergraduate program integrates academic study with clinical experience during the junior and senior years. Clinical experiences will be provided at the ISU Department of Residence Food Service, Iowa Methodist Medical Center, Mary Greeley Hospital, and other health agencies and facilities, both on and off campus. Ten weeks during the senior year are spent at Iowa Methodist Medical Center in Des Moines. This program meets academic and experience requirements of the American Dietetic Association for general dietetics. Planning for this option should begin in the freshman year. Application for admission should be made during the sophomore year and applicants must have a cumulative grade point average of 2.5 Enrollment is limited by the availability of clinical facilities.

Cr.	Degree Requirements
47	Food and nutrition F N 107, 214, 305, 305L, 340, 410, 411, 413, 418, 431, 440, 441, 442, 444, 445, 490
8-9	Communications Engl 104, 105, Sp 211 or 212
23	Home economics C D/F E 201; HE St 101, 401; I Mgt 380, 380L, 434, 435, 436, 438, 481
9	Humanities Select 3 credits from history, 6 credits from Art 280, 281; Dsn S 127, foreign languages; history; literature; Mus 102, 103; philosophy; religious studies
0.5	Library instruction Lib 160
26	Natural sciences and mathematical disciplines B B 301, 311, Biol 110; Chem 163, 163L, 231, 232A; Micro 300; Zool 155, 156
10	Social sciences Econ 201, Psych 230; Soc 134
2-4	Recommended option Select from I Mgt 437, Stat 101 or 104
0.5	Electives
128.5	Total credits

Curriculum in Family Resource Management

Administered by the Department of Family Environment. Leading to the degree Bachelor of Science. Total credits required: 128.5.

This curriculum focuses on the behavior of families as they allocate and manage their resources and function as consumers.

Cr.	Degree Requirements
28	Family environment/home economics F E 185, 370, 378, 391, 491, C D/F E 201, F N 107, HE St 101, 401
16	Option in consumer economics and financial management F E 370L, 415, 471, 488; Econ 401; Jl MC 225
3-4	Select from F E 380, Mgmt 315, Econ 451
18	Select 18 credits with no more than two courses in F E and at least two courses in one department outside F E from: Acct 284, 485; Econ 250, 304, 402, 405, 410, 451; Engl 205 or Phil 271 or Sp 322 or 327; F E 240, 341, 354, 360, 373, 377, 380, 479; Fin 351, 357, 451, 454, 456, 457; F N 319; H S 110; I Ed 140; Mgmt 315; Mkt 340, 447; Pol S 310, 464; Psych 250; Soc 331, 464; T C 464
22	Option in decision making and planned change F E 415, 471, 488; Econ 401, Hist 384; Soc 305, 411
3-4	Select from F E 380, Mgmt 315, Econ 451
12	Select 12 credits with no more than two F E courses from. F E 240, 341, 373, 377; Hist 351, 352; Phil 230; Pol S 305, 306, 310; Soc 345, Sp 317.
25	Option in public policy analysis F E 415, 471, 488; Econ 401, 402, 405; Phil 230; Pol S 306
3-4	Select from: F E 380, Mgmt 315, Econ 451
9	Select 9 credits from. Acct 284; Econ 250, 410, 411, 446, 447, 451; Engl 205; F E 377; Mkt 340; Phil 335; Pol S 310, 311, 320; Soc 305 or Psych 280; Soc 310, 331, 410, 464; T S C 341
41.5	General education
9	Communications Engl 104, 105; Sp 211
9	Humanities Select from: foreign languages, history, literature, music, philosophy
0.5	Library instruction Lib 160
10	Natural sciences and mathematical disciplines Biol 109 or Zool 155; Com S 175; Stat 101
13	Social science Econ 201; Pol S 215; Psych 101 or 250; Soc 134
21-22	Electives
128.5	Total credits

Curriculum in Family Services

Administered by the Department of Family Environment. Leading to the degree Bachelor of Science. Total credits required: 128.5.

This curriculum provides basic preparation for students who desire employment with public or private family service agencies, youth organizations, services to the aged, Cooperative Extension, and other similar employment.

Cr.	Degree Requirements
29	Family environment/home economics F E 185, 370, 370L, 378, 391, 491, F N 107, H Ec 101, 401, C D/F E 201
14-18	Professional courses Select from F E 360, 373, 377, 380, 471, 479, 488
14-18	Related disciplines Select from child development, family environment (housing and the near environment and/or family resource management), psychology, sociology
36.5-37.5	General education
9	Communications Engl 104, 105; Sp 211

9	**Humanities** Select from: foreign language, history, literature, philosophy, music, art (music and art not performing)
0.5	**Library instruction** Lib 160
9-10	**Natural sciences and mathematical disciplines**
7	Zool 155; Stat 101
2-3	Select from: zoology, computer science, statistics, geology, mathematics, physics, chemistry, biology
9	**Social sciences** Select from: Soc 134, Psych 101, Anthr 111, Econ 201, Pol S 215
35-36	**Electives**
128.5	**Total credits**

Curriculum in Fashion Merchandising

Administered by the Department of Textiles and Clothing, leading to the degree Bachelor of Science. Total credits required: 128.5.

The program in fashion merchandising is planned for students interested in careers in the marketing of textiles and clothing products by retailers and manufacturers, within the framework of sound business practices. Choices within this curriculum permit the student to plan a program suited to individual interests

Cr.	Degree Requirements
27	**Textiles and clothing/home economics** T C 121, 165, 204, 245, 275, 480; Art 101, 102; C D/F E 201; F N 107; HE St 101, 401
42-46	**Professional courses**
16-17	T C 304 or 404, 354 or 355, 375, 376, 464, 465
2-3	Select from T C 278; Jl MC 225, 325
9	Select from T C 475; I E 424; Mgmt 315; Mkt 343, 441, 442, 446; Soc 380
3-4	Select from Art 261; F E 240; HE St 210
9	Select from Acct 284; Mkt 340, 447; Psych 250
3-4	Select from Chem 231; Com S 175; Physics 106; Stat 101
	General education
11-12	**Communications:** Engl 104, 105, 302; Sp 211 or 212
9	**Humanities**
3	History 201
6	Select from art history, foreign language, history, literature, music appreciation, philosophy, religion
0.5	**Library instruction** Lib 160
11	**Natural sciences and mathematical disciplines**
3	Biol 109, 110; Zool 155
5	Chem 163, 163L
3	Select from Math 104, 140, 150
10	**Social sciences** Econ 201; Psych 101; Soc 134
13-18	**Electives**
128.5	**Total credits**

Curriculum in Food Science — Food and Nutrition

Leading to the degree Bachelor of Science. Total credits required: 128.5.

Two options are available to the student wishing to major in food science.

I. Option in Consumer Food Science

This option prepares students for careers in consumer services, food industries, and business. Employment opportunities exist in experimental food kitchens, in food product development, food research laboratories, and food promotion and publicity.

Cr.	Degree Requirements
32-33	**Food and nutrition** F N 107, 214, 303, 305, 320, 404, 421, 422, 426, select from 410, 413, or 431
19	**Communications** Engl 104, 105, 414; Jl MC 225, 325; Sp 212, 312
8	**Home economics** C D/F E 201; HE St 101, 401; I Mgt 380, 380L
9	**Humanities** Select 3 credits from history, 6 credits from foreign languages, history, literature, music, philosophy
0.5	**Library instruction** Lib 160
32-33	**Natural sciences and mathematical disciplines** B B 301, 311; Biol 110, 110L; Chem 163, 163L, 231, 232A; Micro 300; Phys 106, Stat 101 or 104, Zool 155
13	**Social sciences** Econ 201; Mkt 340; Pol S 215, Psych 250
13-15	**Electives**
128.5	**Total credits**

II. Option in Food Science

This option is planned for students who are especially interested in emphasizing the natural sciences in relation to food. Graduates have positions in research laboratories in colleges and universities, government agencies, foundations, and food industries. They also have a strong background for graduate study, which is basic to teaching in colleges and universities and for professional advancement in the discipline of food science.

Cr.	Degree Requirements
23	**Food and nutrition** F N 214, 305, 320, 404, 421, 422, 499
11	**Communications** Engl 104, 105, 414; Sp 212
8	**Home economics** C D/F E 201; HE St 101, 401; I Mgt 380, 380L
9	**Humanities** Select 3 credits from history, 6 credits from foreign languages, history, literature, music, philosophy
0.5	**Library instruction** Lib 160.
53	**Natural sciences and mathematical disciplines** B B 404, 405; Biol 110, 110L; Chem 177, 177L, 211, 331, 332, 333A, 334A; Math 165, 166; Micro 300; Phys 111, 112; Stat 104; Zool 155
10	**Social sciences** Econ 201; Pol S 215; Psych 250
14	**Electives**
128.5	**Total credits**

Curriculum in Foodservice Management

Administered by the Department of Institution Management. Leading to the degree Bachelor of Science. Total credits required: 128.5

The curriculum prepares men and women for positions as administrative dietitians, foodservice managers, and foodservice directors. Two options are available. Option I meets the academic requirements for membership in The American Dietetic Association (ADA) and qualifies a student for an internship approved by the Association

In addition, students in the foodservice management curriculum may apply for admission to the Coordinated Undergraduate Program in Dietetics, offered jointly by the Food and Nutrition and Institution Management Departments, as described in Option II Students successfully completing the Coordinated Undergraduate Program meet experience as well as academic requirements of ADA while completing the requirements of the B S degree.

I. Option in Foodservice Management

Cr.	Degree Requirements
25	**Institution management*** I Mgt 287, 380, 380L, 400, 404, 434, 435, 437, 438, 482, 580, 585
29-30	**Other professional courses** Acct 284; An S 371; F N 107, 214, 305, 431; HE St 101, 401, H Ed 410, 413; I E 424, 425
	General education
8.5-9.5	**Communications and library instruction:** Engl 104, 105, Lib 160, Sp 211 or 212
3	**Home economics:** C D/F E 201
9	**Humanities****: Select from foreign language, history, literature, music, philosophy
24	**Natural sciences and mathematical disciplines:** B B 301; Biol 109 or 110, Chem 163, 163L, 231, 232A; Micro 300; Zool 155, 156
10	**Social sciences:** Econ 201, Psych 230; Soc 134
Rec.	**Dance, health studies, and physical education:** P E
18-20	**Electives**
128.5	**Total credits**

*Entering students are expected to have completed intermediate high school algebra. Students not meeting this requirement shall enroll in Math 10 and/or Math 30.

**A list of courses may be obtained in departmental office.

II. Option in Coordinated Undergraduate Program in Dietetics

The Coordinated Undergraduate Program integrates academic study with clinical experience during the junior and senior years Clinical experiences will be provided at the University Department of Residence Food Service, Iowa Methodist Medical Center, Mary Greeley Hospital, and other health agencies and facilities, both on and off campus. Ten weeks

during the senior year are spent at Iowa Methodist Medical Center in Des Moines. This program meets academic and experience requirements of The American Dietetic Association for general dietetics. Planning for this option should begin in the freshman year. Application for admission should be made during the sophomore year, and applicants must have a cumulative grade point average of 2.5. Enrollment is limited by the availability of clinical facilities.

Cr.	Degree Requirements
23	**Institution management***
	I Mgt 380, 380L, 400, 404, 434, 435, 436, 438, 481, 490, 580
46	**Other professional courses**
	Acct 284; F N 107, 214, 305, 305L, 340, 410, 413, 418, 431, 440, 441, 442, 445; HE St 101, 401
2	**Recommended option — I Mgt 437**
	General education
8.5-9.5	**Communications and library instruction:** Engl 104, 105; Lib 160; Sp 211 or 212
3	**Home economics:** C D/F E 201
9	**Humanities****: Select from foreign language, history, literature, music, philosophy
26	**Natural sciences and mathematical disciplines:** B B 301, 311, Biol 110; Chem 163, 163L, 231, 232A; Micro 300; Zool 155, 156
10	**Social sciences:** Econ 201, Psych 230; Soc 134
0-3	**Electives**
128.5	**Total credits**

*Entering students are expected to have completed intermediate high school algebra. Students not meeting this requirement shall enroll in Math 10 and/or Math 30.

**A list of courses may be obtained in departmental office.

Curriculum in General Studies in Home Economics

Administered by the Department of Home Economics Studies, leading to the degree Bachelor of Science. Total credits required: 128.5.

This is a flexible program in home economics for students wishing a general education in home economics, and one of the programs for those desiring to incorporate home economics as part of a preprofessional program. A student wishing to develop a program in general studies should have eduational or professional goals that can best be met by this broader program of study. A statement of these goals must be approved by the department before a program is implemented. Students will be expected to have a minimum of 45 hours of courses at the 300 level or above. See adviser for additional information concerning curriculum planning.

Cr.	Degree Requirements
20-23	**Home economics**
13	HE St 101, 401; C D/F E 201; F E 378 or 488; F N 107; H Ed 410
2-3	Select from Art 101 or HE St 330
3	Select from HE St 210, F E 240, 308, 354, 408

2-4	Select one course from textiles and clothing
33	**Program emphasis**
16	Additional home economics option
17	General education option Select from natural sciences and mathematical disciplines, social sciences, humanities, art and design
8-9	**Communications**
6	Engl 104, 105
2-3	Sp 211 or 212
9	**Humanities**
0.5	**Library instruction**
9	**Natural sciences and mathematical disciplines**
3	Select from Biol 109, 110 or Zool 155
3	Select from physical and mathematical disciplines
3	Additional science option
10	**Social sciences**
4	Econ 201
3	Soc 134
3	Psychology option
35-39	**Electives**
128.5	**Total credits**

Curriculum in Growth and Development of Children

Administered by the Department of Child Development, leading to the degree Bachelor of Science. Total credits required: 128.5.

The curriculum in growth and development of children provides the flexibility of a program useful to students who seek a double major or to those who desire their education to represent broad and philosophical emphases rather than professional-vocational ones. This curriculum also is planned for students who intend to pursue graduate studies in child development or allied areas.

Cr.	Degree Requirements
32.5-33.5	**Child development/home economics**
23.5	C D 129, C D/F E 201, C D 224, 225, 226, 318, 369; F N 107; HE St 101, 401
3-4	Select from C D 240, 341, 342
6	Select from C D 418 or 490R
21	**Professional courses**
3	Select from C D 355, Psych 436
3	Select from Soc 305, Psych 280
6	Select from Psych 430, 431, Soc 461
9	Select from child development, sociology, anthropology, family environment, psychology, statistics
8	**Communications**
	Engl 104, 105, Sp 212
9	**Humanities**
	Select from art history, foreign language, history, literature, music appreciation, philosophy, religion
0.5	**Library instruction**
	Lib 160
10	**Natural sciences and mathematical disciplines**
4	Stat 101
3	Select from Biol 109, 110 or Zool 155
3	Select from natural sciences and mathematical disciplines
12	**Social sciences**
3	Select from American history or American government
3	Anthr 111
3	Soc 134
3	Psych 440
2.5	**Health, dance, and physical education**
2	H S 105
0.5	Select from physical education or dance activity courses
32-33	**Electives**
128.5	**Total credits**

Curriculum in Home Economics Education

Leading to the degree Bachelor of Science. Total credits required: 128.5.

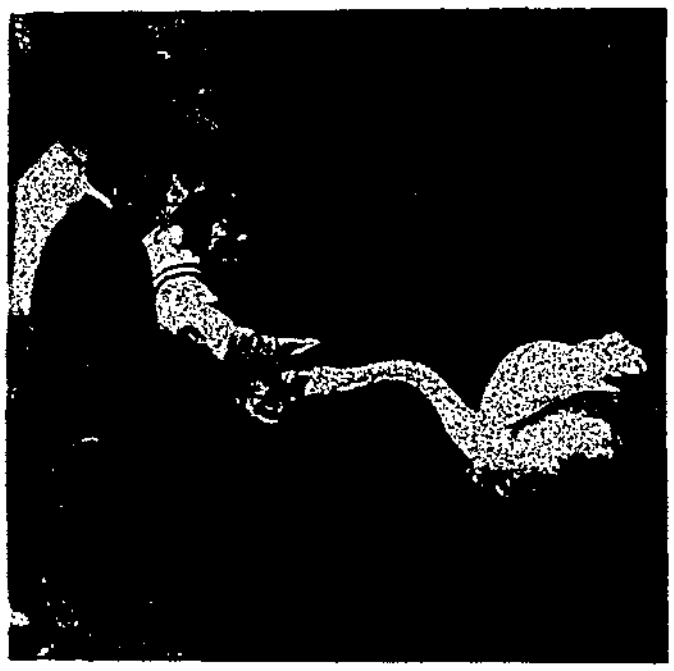
This curriculum is designed for students interested in becoming certified to teach consumer homemaking and diversified home economics occupations in middle, junior and senior high schools. With additional credits, students may also be approved to teach in specific occupational areas: child care, fashion merchandising, and foodservice. Restricted approval to teach health education may be obtained by taking additional credits listed below. Further information about certification program appears under College of Education.

Cr.	Degree Requirements
46-49	**Home economics**
33	C D 224; C D/F E 201; F E 240, 378, 488; F N 107, 208, 301; HE St 101, 401; T C 121, 204
3	Select from C D 225, 226
3	Select from F E 354, HE St 210
3	Select from I Mgt 380 & 380L; F N 303
2-3	Select from T C 166, 245
2-4	Select from F E 370 & 370L, 415; HE St 420
28	**Professional Courses**
	H Ed 206, 318, 410, 412, 417, 419, 420; Psych 333; SecEd 204, 301, 406, 426
43.5-45.5	**General education**
8-9	**Communications:**
	Engl 104, 105; Sp 211 or 212
12-13	**Art and Humanities*:**
3	Select from American history or American government
3-4	Select from Art 101, 102, or 261

6	Additional courses from approved list in departmental office
0.5	**Library instruction** Lib 160
12	**Natural sciences and mathematical disciplines** Chem 163, 163L, 231, 232; Zool 155
10	**Social sciences** Econ 201; Psych 230; Soc 134
1	**Dance, health, physical education**
6-11	**Electives**
128.5	**Total credits**

Additional secondary teaching options available:
Child care: C D 341, 342, 443, 445
Fashion Merchandising T C 275, 375, 376, Acct 284
Food Service: Biol 109; Imbio 300; I Mgt 380, 380L, 434, 438
Health education: H S 110, 215, 250, 310, 375, 390; Zool 156

*A list of approved courses may be obtained in departmental office.



Curriculum in Home Economics Journalism

Administered by the dean of the College of Home Economics with the cooperation of the Department of Journalism and Mass Communication.

Leading to the degree Bachelor of Science Total credits required: 128.5.

This curriculum prepares students for professional communications careers in mass media, business, industry, government, and institutions with concerns for transmitting technical information and new knowledge to varied audiences of individuals and families

Journalism is combined with a concentration in a particular area of home economics The student plans an individualized program with the aid of the academic journalism adviser and in consultation with the home economics department in which the student selects a concentration.

Two choices are made to define the individual program — a specialization in a career area in journalism and a concentration in a home economics subject matter area. Electives may expand the concentration into a double major, extend to a second area concentration, or be chosen from related and complementary courses.

Cr.	Degree Requirements
31-32	**Home economics**
8	HE St 101, 401; C D/F E 201; F N 107
15*	Selected concentration
2-3	Management option
6	Additional home economics
30-32**	**Journalism and mass communication**
10	Jl MC 101, 201, 202, 203
9-10	Jl MC 300-level skills courses (must include one from 345, 352, 354, 360, 361, 370)
6	Jl MC 430, 491, 499
5-6	Jl MC 400-level advanced courses (must include one from 410, 431, 462)
37.5	**General education**
6-9	**Communications:** Engl 104, 105; Sp 211 or 212
0.5	**Library instruction:** Lib 160
9	**Humanities:** Select from art, drama appreciation, foreign language, history, literature, music appreciation, philosophy, religion
9	**Natural sciences and mathematical disciplines**
3	Biol 109 or Zool 155
6	Select from chemistry, biochemistry, biology, zoology, computer science, mathematics, statistics
10	**Social sciences:** Econ 201; Pol S 215; Soc 134 or Psych 230
27-31***	**Electives**
128.5	**Total credits**

*The particular courses required are a function of the concentration selected and may include more credits than the minimum. See H Jl coordinator.

**National journalism accreditation standards recommend that the number of journalism credits in the degree program be limited to approximately one-quarter of total credits taken.

***Some elective credit may be used to fulfill prerequisites for courses in the home economics concentration, to fulfill college core education requirements, or to extend the minimum home economics concentration. See H Jl coordinator.

Curriculum in Hotel and Restaurant Management

Administered by the Department of Institution Management. Leading to the degree Bachelor of Science. Total credits required: 128.5.

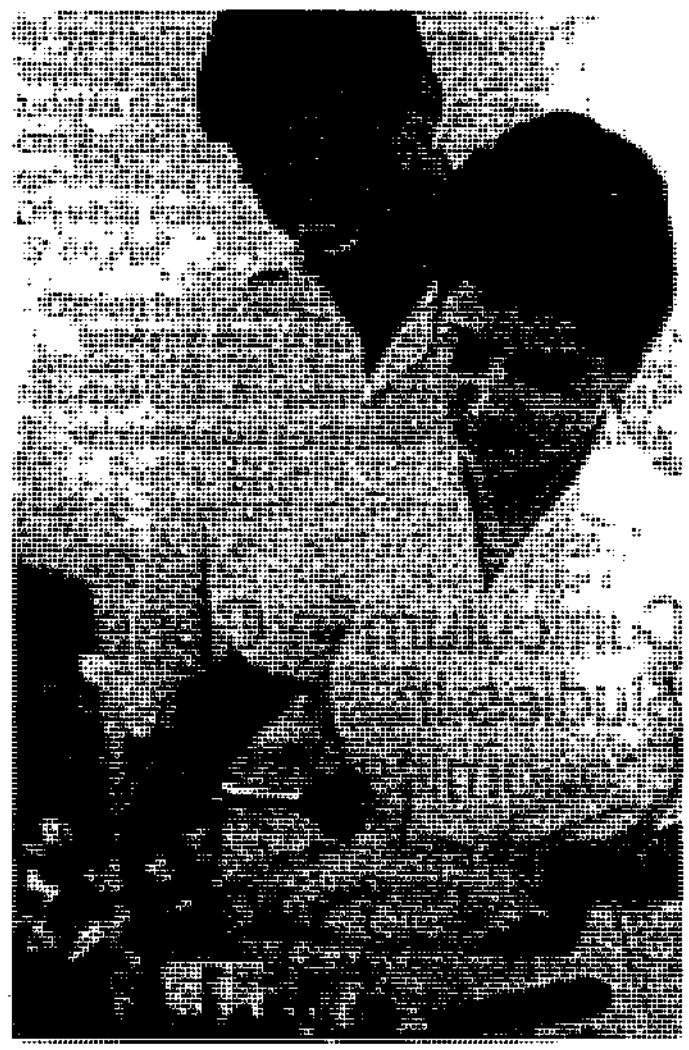
The curriculum in hotel and restaurant management prepares men and women for a variety of managerial positions in hotels, motels, restaurants, clubs, residence halls, and other types of establishments providing lodging and foodservice. Graduates are eligible for membership in a variety of national associations.[1]

Cr.	Degree Requirements
27-28	**Institution management[2]** I Mgt 287, 380, 380L, 400, 404, 434, 435, 438, 450, 460, 482. Select 4-5 credits from: I Mgt 437, 483, 580, 585
	Other professional courses:
31	**Required:** Acct 284; An S 371; Com S 170; Con E 350; F N 107, 207; H E St 101, 220, 401; I E 424, Mgmt 315; Mkt 340; Stat 227
9	**Select from:** Labor — Econ 404; I E 425 Advertising — Engl 302, Jl MC 325, Mkt 430, 441, 447 Finance — Acct 285, Econ 304, Fin 350
	General education
8.5-9.5	**Communications and library instruction:** Engl 104, 105, Lib 160, Sp 211 or 212
3	**Home economics:** C D/F E 201
9	**Humanities[3]:** Select from foreign language, history, literature, music, philosophy
14	**Natural sciences and mathematical disciplines:** Biol 109; Chem 163, 163L; Math 150; Micro 300
10	**Social sciences:** Econ 201, Psych 101 or 230; Soc 134
Rec.	**Dance, health studies, and physical education:** P E
15-17	**Electives**
128.5	**Total credits**

[1]By early, careful planning of program and use of electives, a student may meet the academic requirements of The American Dietetic Association.

[2]Entering students are expected to have completed intermediate high school algebra. Students not meeting this requirement shall enroll in Math 10 and/or Math 30

[3]A list of courses may be obtained in departmental office.



Curriculum in Housing and the Near Environment

Administered by the Department of Family Environment. Leading to the degree Bachelor of Science. Total credits required: 128.5.

This curriculum focuses on housing as a basic issue in the environment of individuals and families.

Cr.	Degree Requirements
28	**Family Environment/Home Economics** F E 185, 370, 378, 391, 491, HE St 101, 401, C D/F E 201, F N 107

Option in Household Equipment

15 F E 308, 354, 408, 410, 412

14 Select 14 credits from at least three areas: Acct 284; Arch 360, 466, 467; Art 101, 102, 203, 364, 465; Chem 231; Dsn S 137; Fin 351; I E 274, 424; Jl MC 225, 325, 352; Mgmt 315, 316, 370; Mkt 340, 343; Phys 101, 106, 111, 112; Psych 250, 350, 382; Soc 219, 264, 310, 331, 350, 382, 410; Sp 106, 311, 312, 317, 332; Stat 104, 105; other F E courses.

Option in Housing

20 F E 240, 308, 341, 360, 412, 446, Com S 175

14 Select 14 credits from at least three areas Acct 284; Arch 360, 466, 467, Art 101, 102, 203, 364, 465, Com S 112, 172; C R P 253, 270, 293, 395, 405, Dsn S 137, Fin 351, Fr E 145, Mgmt 315, 316, 370; Mkt 340, 343, Soc 219, 264, 310, 331, 350, 382, 410; Stat 104, 105, other F E courses.

Option in Housing — Home Furnishings

30 F E 240, 308, 341, 412, 446, Art 261, HE St 210, 220, 330, T C 204

14 Select 14 credits from at least three areas Acct 381; Arch 360, 466, 467, Art 101, 102, 203, 364, 465, C R P 253, 270, 293; Dsn S 137; Mgmt 315, 316, T C 304, 355; other F E courses

36.5 **General education**

9 **Communications**
Engl 104, 105; Sp 211

9 **Humanities**
Select from foreign language, history, literature, music, philosophy

0.5 **Library instruction**
Lib 160

9 **Natural sciences and mathematical disciplines**

3 Biol 109 or 110 or Zool 155

6 Select from computer science, statistics, geology, meteorology, math, physics, chemistry

9 **Social science**
Economics, sociology, psychology, anthropology, geography, political science

20-35 **Electives**

128.5 **Total credits**

Curriculum in International Studies in Home Economics

Administered by the Department of Home Economics Studies, leading to the degree Bachelor of Science Total credits required 128.5.

Designed to provide students with a background for participation in government or agency programs, as well as provide an opportunity to become oriented to national and international affairs as part of the responsibility of citizenship in its broadest sense. Students are encouraged to pursue a double major. See adviser for additional information concerning curriculum planning.

For further information see Index, *International Studies* For specific degree program write: Associate Dean, College of Home Economics

Cr. **Degree Requirements**

43-48 **Home economics**

23 HE St 101, 401, C D /F E 201; F E 240, 378, F N 107; H Ed 410, 413, T C 204, 221

2-3 Select from Art 101, HE St 210, 330

3 Select from C D 224, 225, 226

3-5 Select from F N 208, 214

12-14 Additional home economics option*

8-9 **Communications**

6 Engl 104, 105

2-3 Sp 211 or 212

16 **Foreign languages**
Minimum of 2 years in one language

0.5 **Library instruction**

16 **Natural sciences and mathematical disciplines**

8 Chem 163, 163L, 231

3 Select from Biol 109, 110, or Zool 155

5 Additional science option

4 **Seminar in university studies**

4 U St 230, 430

20 **Social sciences**

3 American government

3 Anthropology

4 Economics

3 Sociology

7 Additional social science option

6 **Study of a single geographic area**
See Index, *International Studies*
Select from Africa, Asia, Latin America, Middle East; Russia, or Western Europe.

9-15 **Electives**

128.5 **Total credits**

*The particular courses chosen are a function of the program emphasis selected and may include more credits than the minimum. See home economics studies coordinator.

Curriculum in Nutritional Science — Food and Nutrition

Leading to the degree Bachelor of Science. Total credits required. 128.5.

This curriculum is planned for students who are particularly interested in stressing the physical and biological sciences in relation to nutrition. Graduates have positions in research laboratories in colleges and universities, medical laboratories, foundations, and industry. They also have a strong background for graduate study, which is basic to teaching in colleges and universities and for professional advancement as a nutritionist.

Cr. **Degree Requirements**

23-24 **Food and nutrition**
F N 214, 305, 305L, 404, 490, 499, select 7-8 credits from 410, 413, 431

11 **Communications**
Engl 104, 105, 414; Sp 212

5 **Home economics**
C D/F E 201; HE St 101, 401

18 **Humanities and social sciences**
French 101 and 102, German 101 and 102, Russian 101 and 102, or Spanish 101 and 102; select 3 credits from history; select 7 credits from social sciences

0.5 **Library instruction**
Lib 160

2-3 **Management**
Select from F N 303; Mgmt 370; I Mgt 287, or 380 and 380L.

56-59 **Natural sciences and mathematical disciplines**
B B 404; Biol 110, 110L; Chem 177, 177L, 211, 331, 332, 333A, 334A; Micro 300; Phys 111, 112; Stat 101, 401, Zool 206, 206L, 355; select 3-6 credits from B B 405, 411, 451.

8-13 **Electives**

128.5 **Total credits**

Curriculum in Teaching Prekindergarten-Kindergarten Children

Administered by the Department of Child Development, leading to the degree Bachelor of Science. Total credits required: 128.5

The student selecting the curriculum in teaching prekindergarten-kindergarten children may choose one of two options: prekindergarten-kindergarten certification; or preschool handicapped approval. Both options prepare the student to meet state certification requirements for teaching prekindergarten-kindergarten children. Option 2 leads to an additional state approval to teach preschool handicapped children.

Option 1 — Prekindergarten-kindergarten Certification.

Cr.	Degree Requirements
36.5	**Child development/home economics**
30.5	C D 129, C D /F E 201, C D 318, 341, 342, 369, 443, 445, 449; F N 107; HE St 101, 401
6	Select from C D 224, 225, 226
27	**Professional courses**
6	El Ed 204, 301, 406
3	Psych 333
12	C D 417A, 417B
6	Select from C D 240, Sp 362, Mus 364, P E 284, El Ed 447
8	**Communications** Engl 104, 105, Sp 212
9	**Humanities** Select from art history, foreign language, history, literature, music appreciation, philosophy, religion
0.5	**Library instruction** Lib 160
9	**Natural sciences and mathematical disciplines**
3	Zool 155
3	Select from physical sciences, statistics, mathematics
3	Select from biological sciences, physical sciences, statistics, mathematics
12-13	**Social sciences**
3	Select from American history or American government
3	Anthr 111
3	Soc 134
3-4	Select from economics or psychology
2.5	**Health, dance, and physical education**
2	H S 105
0.5	Select from physical education or dance activity courses
23-24	**Electives**
128.5	**Total credits**

Option 2 — Preschool Handicapped Approval

Cr.	Degree Requirements
42.5	**Child development/home economics** C D 129, C D/F E 201, C D 224, 225, 318, 341, 342, 355, 369; 443, 445, 449, 455; F N 107; HE St 101, 401
35	**Professional courses**
9	El Ed 204, 301, 360, 406
3	Psych 333
2	Select from P E 390 or 392
3	Sp 275
12	C D 417A, 417C
6	Select from C D 226, 240, Sp 362, Mus 364, P E 284
8	**Communications** Engl 104, 105, Sp 212
9	**Humanities** Select from art history, foreign language, history, literature, music appreciation, philosophy, religion
0.5	**Library instruction** Lib 160
9	**Natural sciences and mathematical disciplines**
3	Zool 155
3	Select from physical sciences, statistics, mathematics
3	Select from biological and physical sciences, statistics, mathematics
9	**Social sciences**
3	Select from American history or American government
3	Anthr 111
3	Soc 134
2.5	**Health, dance, and physical education**
2	H S 105
0.5	Select from physical education or dance activity courses
13	**Electives**
128.5	**Total credits**

Curriculum in Textiles and Clothing Related Science

Administered by the Department of Textiles and Clothing, leading to the degree Bachelor of Science. Total credits required: 128.5.

The curriculum in textiles and clothing related science is designed for those who wish to prepare for advanced study leading to careers in college teaching or research. The physical science option prepares the student for research in textiles and forms a foundation for further study. The social science option is designed for the student interested in the historic, economic, sociological or psychological aspects of clothing and textiles.

Cr.	Degree Requirements
27	**Textiles and clothing/home economics** T C 121, 165, 204, 245, 275, 480; Art 101, 102; C D/F E 201; F N 107 HE St 101, 401

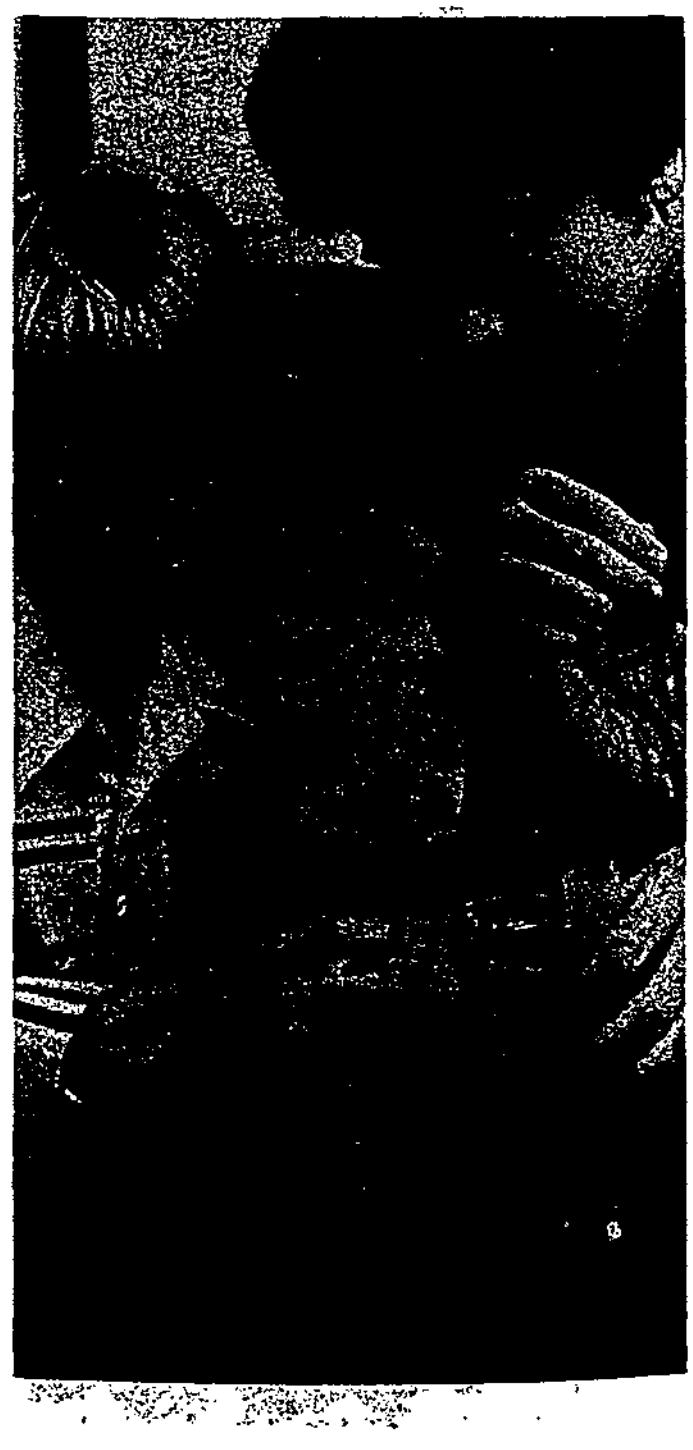
Option in Physical Science

26-30	**Professional courses**
14-15	T C 304, 355, 404, additional T C
10-12	Com S 111 or 172, Phys 111 or 221, Stat 101
2-3	Select from I Mgt 287, F E 378, 415, 488
	General education
11-12	**Communications:** Engl 104, 105, 414; Sp 211 or 212
9	**Humanities:**
3	History 201
6	Select from art history, foreign language, history, literature, music appreciation, philosophy, religion
0.5	**Library instruction:** Lib 160
25	**Natural science and mathematical disciplines:**
3	Select from Biol 109, 110; Zool 155
22	Chem 163, 163L, 164, 164L, 231, 232B; Math 165, 166
10	**Social sciences** Econ 201; Psych 101; Soc 134
15-20	**Electives**
128.5	**Total credits**

Option in Social Science

Cr.	Degree Requirements
39-43	**Professional courses**
17-18	T C 221 or 222, 354, 355, 464, 465, additional T C
6-8	Social science theory*
3-4	Social science methods*
9	Additional credits from anthropology, economics, history, psychology, or sociology
4	Stat 101
	General education
11-12	**Communications** Engl 104, 105, 414; Sp 211 or 21
10-11	**Humanities**
3	Hist 201
7-8	F Lng
0.5	**Library instruction** Lib 160
14	**Natural sciences and mathematical disciplines**
3	Select from Biol 109, 110; Zool 155
8	Chem 163, 163L, 231
3	Select from Math 140, 142, 150
10	**Social sciences** Econ 201; Psych 101; Soc 134
11-18	**Electives**
128.5	**Total credits**

*Department office will provide a current listing of suggested courses.



College of Sciences and Humanities

Wallace A Russell, Dean
Chalmer J Roy, Emeritus Dean
Thomas W Turnage, Associate Dean
Richard J Van Iten, Associate Dean
M R Kratochvil, Assistant Dean
Ruth W Swenson, Assistant Dean

Administrative Units of the College

Schools

Business Administration

Departments

Air Force Aerospace Studies
Biochemistry and Biophysics
Botany
Chemistry
Computer Science
Earth Sciences
Economics
English
Foreign Languages and Literatures
History
Library
Materials Science and Engineering
Mathematics
Microbiology
Military Science
Music
Naval Science
Philosophy
Physics
Political Science
Psychology
Sociology and Anthropology
Speech
Statistics
Zoology

The College of Sciences and Humanities affords students the opportunity to pursue a wide and rich range of program options within the context of a modern liberal arts setting. By way of single or multiple majors, students study in depth a discipline or disciplines of their choice. The dimension of meaningful breadth is acquired by way of satisfying general education requirements and judiciously selecting elective courses.

Serving as the academic home for many basic learning disciplines, the College of Sciences and Humanities includes all the components of a modern liberal arts college, offering opportunities for study in many fields of the physical, biological, and social sciences; in mathematical disciplines; in methods and systems of communication; and in the arts and humanities. The School of Business Administration within the College provides instruction in the professional areas of business

The flexible degree requirements in the curriculum in sciences and humanities permit programs of study suited to a variety of interests and goals. The curricula in business administration and in music are directed to professional development in those specified areas Students having academic interests not fully met by a traditional major may apply for an individual major, a program of study which bridges traditional academic programs, or they may integrate three areas of concentration in a distributed studies major The College participates in the University Honors Program; thus, students of exceptional academic promise can develop unique and challenging programs of study

The college has four curricula. a curriculum in sciences and humanities, leading to the Bachelor of Arts or the Bachelor of Science degree; a curriculum in business administration, leading to the Bachelor of Business Administration degree; a curriculum in music, leading to the Bachelor of Music degree; and an external curriculum in the liberal arts, leading to the Bachelor of Liberal Studies degree.

High School Preparation

Preparation for entrance into the college should include 4 years of English composition and rhetoric; 1 year of geometry; 1½ years of algebra; 2 years of science (chemistry, physics or biology); and 2 years of a foreign language. Moreover, students planning to study a science or in a science-related discipline should complete ½ year of trigonometry and an additional ½ year of algebra or analytic geometry. Deficiencies in any of these areas may prevent students from making normal progress in a college curriculum and adversely affect their academic records.

Foreign Language, 1983-85

Students entering the college fall semester 1983 and afterwards will have a graduation requirement equivalent to the first year of university level study in a foreign language, except that students in the curriculum in business administration will have the option of meeting the requirement through a two-semester study of foreign culture. The requirement may be met by satisfactory performance on a college language examination, and high-school students are encouraged to prepare to do so through two years of study of a language in high school. If they have completed two or more years of high school study in the same foreign language with an average grade of 2.00 on a 4.00 system, then they may choose to meet this requirement with a minimum of six credits in a two-semester study dealing with foreign cultures. If they have completed three or more years of high school study in the same foreign language with an average of 2.00 on a 4.00 system, then they will be considered to have met this requirement. Students who have a strong foreign language preparation are encouraged to attempt to acquire college credit by taking a test-out examination which is administered each semester by the Department of Foreign Languages and Literatures

Transfer Students

To graduate from the College of Sciences and Humanities, a transfer student must complete the general requirements of the college as well as those of the University. Students planning to transfer to Iowa State University for the purpose of enrolling in the College of Sciences and Humanities are advised to contact the College Office, 204 Carver Hall, for information concerning degree program requirements. Prospective transfer students are urged to learn about the academic programs that are of interest to them well before arriving on campus in order to prepare for admission by taking courses which are appropriate to the planned major and transferable toward graduation from ISU. Additional information concerning transfer credit evaluation may be obtained through the Admissions Office as well as the department responsible for the major discipline in which a student is interested.

Transfer students may defer selection of a major for at least the first semester of enrollment.

A transfer student in the College of Sciences and Humanities may choose to graduate under the catalog in effect at the time of his or her graduation or under one of the two immediately preceding catalogs, provided it covers the period of his or her enrollment either at Iowa State or any other accredited school preceding enrollment at Iowa State. Full requirements of the chosen catalog must be met except that adjustments will be made in instances where courses are no longer available or where programs have been changed. A transfer student is responsible for reviewing his/her transfer credit evaluation with the academic adviser during the first semester of enrollment. A transfer student who has earned more than 77 college credits must submit a degree program by midterm of the semester following entry.

College and University Bachelor's Degree Requirements

To obtain a baccalaureate degree from the College of Sciences and Humanities, an undergraduate student must earn a minimum of 32 Iowa State University semester credits at least 8 of which are in the student's major and in which the student's grade is C or higher. At least 47 of the total credits presented for the degree must be in courses numbered 300 or above (transfer credits in this category must be from a four-year college). Courses taken on a Pass/Not Pass basis may be applied toward graduation only as electives.

The University bachelor's degree requirements, including statements of academic standards, the University residence requirement, the English proficiency requirement, and the library requirement, appear on page 26.

Curriculum in Sciences and Humanities

For the degree Bachelor of Arts or Bachelor of Science, the student must earn a total of at least 124.5 credits distributed as follows.

Cr.	Basic Education Requirements
6	English 104, 105
0	Foreign language/culture Note that in 1983 this is to become 6 or 8
0.5	Library 160

General Education Requirements

A. Students must earn the minimum credits listed in each of the four general education groups in courses outside the department of the first major listed on the degree program.

B. Students must either earn a minimum of 34 credits among the groups outside the group of the major or meet the foreign language requirement specified for 1983 and beyond and earn 26 credits among the three groups outside the group of the major. Majors in English and foreign languages and literatures are identified with group I. Students majoring in journalism and mass communication or in speech will earn 40 credits among groups I, III, and IV and 100- and 200-level foreign language courses or meet the foreign language requirement for 1983 and beyond and earn 32 credits among groups I, III, and IV

Students who complete two or more majors will meet this requirement with respect to only one major

Major

Students must complete the requirements of a major which will include 24 to 48 credits in the major discipline as specified by the major department or discipline. Some courses outside the major discipline may also be required as supporting work for the major. Courses in the department or discipline of the first major listed on the degree program may not be counted in the general education groups. Courses in basic and general education may be counted in meeting the requirements of additional majors.

Minor

A minor, which is optional, must consist of at least 15 credits, with at least 6 credits in courses numbered 300 and above taken at ISU with a grade of C or higher, in the department or discipline of the minor. Most departments and programs will specify requirements for a minor in their discipline; graduates who complete such requirements will have the minor recorded on their transcripts. Courses in basic and general education may be used to meet the requirements of a minor.

Electives

Students will take additional courses (approximately 24 credits) freely elected, sufficient to accumulate a total of 124.5 credits. These additional courses together with the general education courses may be used to meet the requirements of a minor or of another major

General Education Groups

I. **Arts and humanities** (minimum 12 credits, including an integrated two-semester sequence or collection of courses in History, in literature from English or Foreign Languages and Literatures, in Philosophy, or in Religious Studies). The student should develop an understanding of human cultural heritage and history, and an appreciation of reasoning and the aesthetic value of human creativity*

II. **Verbal communication** (minimum 2 credits). The student should develop skills in and an understanding of the principal areas which serve as a basis for effective communication among people.*

III. **Natural sciences and mathematical disciplines** (minimum 11 credits including 3 in the mathematical disciplines and 8 in the natural sciences). The student should experience science as a rational search for understanding of the structure and behavior of the natural world, and should appreciate mathematics as an intrinsically important way of thinking and a valuable tool of the sciences.*

IV. **Social sciences** (minimum 9 credits). The student should develop an understanding of the structure and dynamics of human social institutions, personality, and interpersonal relations.*

*Lists of approved courses are available from advisers or the Office of the Dean, College of Sciences and Humanities.

The Major

Departments may require more than 24 credits in the major and specify other requirements not stated as college requirements. (See Index for page reference to individual department and program requirements). The major must contain at least 8 credits in courses taken at Iowa State University that are numbered 300 or above and in which the student's grade is C or higher Courses in the first major listed on the student's degree program may not also be included in the general education groups.

The major shall be chosen from the following list, which also indicates the degree(s) offered in the respective majors:

Anthropology, B.A., B.S.; biochemistry, B.S., biology, B.S.; biophysics, B.S.; botany, B.S.; business administration, B.S.; chemistry, B.A., B.S.; computer science, B.S.; earth science, B.A., B.S.; economics, B.A., B.S.; English, B.A., B.S.; environmental studies (may be taken as a second major with the degree to be determined by the first major); French, B.A., geology, B.A., B.S.; German, B.A.; history, B.A., B.S., international studies (may be taken as a second major with the degree to be determined by the first major); journalism and mass communication, B.A., B.S.; mathematics, B.S.; metallurgy, B.S., meteorology, B.A., B.S.; microbiology, B.S., music, B.A., naval science, B.S., philosophy, B.A.; physics, B.S.; political science, B.A.; psychology, B.S.; Russian, B.A., sociology, B.A., B.S.; Spanish, B.A., speech, B.A., B.S., statistics, B.S.; zoology, B.S.

Individual majors (B.A., B.S.) and distributed studies majors (B.A., B.S.) provide broad, cross-disciplinary programs of study where appropriate. (See Index, *Cross-Disciplinary Studies.)*

Students may elect a second major from the departments and program areas listed above, or from a major field offered for the bachelor's degree in another college of the University. Both major departments must then approve the degree program, and if those majors involve two colleges, both deans must approve. Such programs must fulfill the curriculum requirements of the College of Sciences and Humanities. If one major leads to the B.A. degree and the other to the B.S. degree, a student may elect the degree to be awarded. A student also may choose between the B.A. and B.S. degrees if one major offers both and the other major offers only one, provided the latter department is willing to defer. In all cases, the requirements for the elected degree must be met.

A student may earn both a B.A. and a B.S. degree in this curriculum with two appropriate majors and at least 30 additional credits Either the B.A. or the B.S. in this curriculum may be earned with the Bachelor of Music or the Bachelor of Business Administration. Any degree offered by this college may be earned together with a degree with a major in any other college of the University. Two B.S. degrees or two B.A. degrees cannot be earned in this curriculum even with different majors. For the requirements for two degrees, see Index, *Bachelor's Degree Requirements*.

The Minor (optional)

The student may elect a minor, which must consist of at least 15 credits including 100-level courses, with at least 6 credits in courses numbered 300 and above taken at ISU with a grade of C or higher, in the department or discipline of the minor. In most disciplines there are specified minor requirements of 15-21 credits with no additional prerequisite courses within the discipline; a graduate who has completed such requirements will have the minor recorded on his or her transcript The minor may be chosen from the list of majors or from air force aerospace studies, astronomy, genetics, military science, telecommunicative arts, theatre, or from majors offered in other colleges A minor may include courses from two or more closely related areas if they form a strong and coherent program directed toward definite educational objectives. Examples of such minors are American Indian studies, classical studies, gerontology, linguistics, religious studies, teacher education, and women's studies.

Other Requirements

English Proficiency

The faculty of Iowa State University believes that its graduates should acquire competence in written communication during their undergraduate careers. All students must, therefore, complete or test out of a sequence of basic composition courses, normally in the freshman year. Every major department must certify that each of its candidates for graduation has achieved an adequate level of proficiency in written communication.

To assure that a student can meet this requirement and to provide continued development of communication skills after the freshman year, the student's major department may (1) require, and provide critical evaluation of, term papers and other written assignments within courses offered by the department, (2) encourage students to enroll in advanced English composition courses, (3) refer students to the Writing Center operated by the Department of English. For requirements in specific majors, see the appropriate department or program listing.

Library Proficiency

A library minimum proficiency requirement must be met by satisfactory completion of one of the following options:

1 Library 160

2 A test-out examination for credit to be administered by the library staff, who will control the testing procedure and will determine those students who are eligible to take the examination.

Planning the Program of Study
No fixed schedule of courses is required of students in the sciences and humanities curriculum. Each student plans a schedule of courses for each term with guidance from an academic adviser. Schedules of courses may vary widely in accordance with a student's major area, special interests, and educational goals

During the first year, students should meet proficiency requirements in English and in library They should also make progress toward meeting the general education requirements, a large part of which should be completed by the end of the second year The third and fourth years should emphasize completion of the major (and minor, if elected) and of general education requirements, and should give the student opportunity to take electives.

Careful, comprehensive planning, rather than selection of courses semester by semester, should culminate in a sound liberal arts program. Each student is encouraged to work with his or her academic adviser in developing such a plan. A formal degree program listing all courses taken and those remaining to be taken in fulfillment of the degree requirements must be submitted not later than the third semester before graduation (as soon as 77 or more credits have been earned). This period of time is essential to assure that, if errors or omissions appear in a degree program, the student will have sufficient time to make the necessary adjustments in course scheduling without the danger of delay in graduation. The program must be approved by the student's major department or discipline and by the dean of the College of Sciences and Humanities If there is more than one major department or program, the chairman of each must approve. Appropriate changes may be made at any time with the approval of both the department and the dean but may delay graduation if submitted during the final semester.

The Open Option
Recognizing the fact that many students entering Iowa State University will not have selected a major, the College of Sciences and Humanities has created the Open Option in order to give them time to explore possible majors and programs. A course, S-H 100, Career Planning for Open Option Students, is available to assist these students (see Index, *Sciences* and *Humanities, Cross-Disciplinary Studies)* Open Option students who enter as freshmen are expected to declare a major by the beginning of the fourth semester of enrollment. Entering students who have completed three semesters in another school and students who wish to change majors but are not yet ready to declare the new major may register under the Open Option for one semester.

Program planning information is available through advisers of Open Option students, departmental offices, and the Sciences and Humanities Dean's Office for students with potential interest in majoring in some area of (1) arts and humanities, (2) biological sciences, (3) communication, (4) mathematical disciplines, (5) physical sciences, or (6) social sciences *Early enrollment in certain course sequences is essential for students who are considering sciences or mathematical disciplines, and selection of a major field by the end of the first year is strongly recommended.*

Honors Program
For information on the Honors Program in the College of Sciences and Humanities, see Index, *Sciences and Humanities, Cross-Disciplinary Programs, Honors Program.*

ROTC Programs
The College of Sciences and Humanities also offers students the opportunity to combine their academic programs with ROTC programs in the Army, Navy, and Air Force

Teacher Certification
Students in the College of Sciences and Humanities may be recommended for the Iowa Professional Certificate for full-time teaching of certain subjects in secondary schools. For further information see Index, *Sciences and Humanities, Teacher Education Program.*

Preprofessional Programs
Students in the College of Sciences and Humanities may enroll in preprofessional programs in human health-related fields, law, speech-language pathology and audiology, and theology, and complete the requirements for admission to professional schools. For a bachelor's degree, the student declares a major, selected from those offered by the college, and submits a degree program. Up to 32 semester credits of appropriate course work may be transferred back from some professional schools and applied toward a bachelor's degree in the College of Sciences and Humanities. For further information, see Index, *Preprofessional Study.*

Program in Preveterinary Medicine
Students in the College of Sciences and Humanities may enroll in the Preveterinary Medicine Program and complete the requirements for admission to the College of Veterinary Medicine under the guidance of preveterinary medicine advisers. A major (commonly biology, chemistry, distributed studies, microbiology, or zoology) is declared, usually by the junior year. With careful planning, students who are admitted to the College of Veterinary Medicine after three years of undergraduate work may use credits from the first year of professional study to complete the requirements for a bachelor's degree in the College of Sciences and Humanities.

Curriculum in Music

This curriculum leads to the degree Bachelor of Music and is an alternative to the curriculum in sciences and humanities with a major in music At least 126 5 credits, in accordance with the requirements specified below, must be earned for graduation.

Cr.	
14.5	**Basic Education Requirements**
6	English 104, 105
0 5	Library 160
8	Foreign language (one)
32	**General Education Requirements** (Students choosing the music education option should consult their advisers regarding general education requirements)
6	Social sciences
6	Two-semester integrated sequence in humanities
6	Music 383, 384
8	Physics 198, 199; mathematical, physical, and biological sciences
6	Electives
46	**Music core**
21	Music 120, 230, 231, 330, 331, 361
12	Music 119, 219, 319, 419
3	One of the following: Music 472, 473, 474, 475
3	One of the following: Music 430, 440, 448
7	Ensembles
34-44	**Music major** (select one of the following options)
34	**History and literature**
12	Additional music history
3	Additional music theory
8	Additional foreign language
11	Electives
36-44	**Music education** **Certification options:**
36	1) Vocal, 7-12. (a) SecEd 204, 301, 406, 426; Psych 333; (b) S-H 417K; Music 360, 362A, 465, 466; (c) 4 additional credits in applied music; electives, 3 credits
40	2) Vocal, K-12. (a) (b) same as (a) and (b) above; (c) C D 226, S-H 417L; 4 additional credits in applied music
43	3) Instrumental K-12. (a) same as (a) above; (b) S-H 417K, S-H 417L; C D 226; (c) Music 350, 351, 352, 353, 354, 355, 356, 362B, 464, 466
44	4) Instrumental, K-6. (a) El Ed 204, 301, 406; Psych 333; (b) S-H 417L; C D 129, 226, 342; (c) Music 350, 351, 352, 353, 354, 356, 362B, 365, 466
44	5) Vocal, K-6. (a) El Ed 204, 301, 406; Psych 333; (b) S-H 417L; C D 129, 226, 342; (c) Music 360, 362A, 364, 365, 466; 4 additional credits in applied music
34	**Organ**
4	Music 119B, 219B
8	Music 319C, 419C
8	Music 471, 472, elective in music history
3	Additional music theory
8	Additional foreign language
3	Electives
34	**Piano**
12	Music 119, 219, 319, 419
9	Music 471, independent study (literature and pedagogy)
3	Music 321, 290F (chamber music and accompanying)

3	Additional music theory
7	Electives
34	**String instruments**
12	Music 119, 219, 319, 419
6	Music 181, 321
3	Additional music theory
4	Independent study (literature, pedagogy)
9	Electives
34	**Theory and composition**
8	Applied music
4	Music 362A, 362B
13	Additional music theory and composition
9	Electives
34	**Voice**
4	Music 119B, 219B
8	Music 319A, 419A
6	Music 324, 325, 360
3	Additional music theory
2	Independent study (vocal literature)
8	Additional foreign language
3	Electives
34	**Wind or percussion instrument**
12	Music 119, 219, 319, 419
2-4	Music 351-352 or 353-354 or 355; 356
3	Music 321
3	Additional music theory
4	Independent study (literature, pedagogy)
8-10	Electives
126.5-136.5	Total credits

Curriculum in Business Administration

This curriculum leads to the degree Bachelor of Business Administration with a major in either accounting, finance, management, marketing, or transportation/logistics Students interested in a general business major study in the curriculum in sciences and humanities with a major in business administration.

For the degree Bachelor of Business Administration the student must complete 124.5 semester credits distributed as follows

Cr.	**Degree Requirements**
	Basic Education
6	English 104, 105
0	Foreign language/culture Note that in 1983 this is to become 6 or 8
0.5	Library
41	**General Education**
9	**I. Humanities and natural sciences** One course in philosophy or religious studies, one course in natural science, choice of humanities and/or natural science.
6	**II. Verbal communication**
3	Engl 302 or 414
3	Sp 211
13	**III. Mathematical disciplines**
6	Math 150, 151
4	Stat 227
3	Computer science
7	**IV. Economics**
4	Econ 201
3	One of Econ 304, 401 or 404
6	**V. Non-economics social science**
	Business
27	**A. Core**
6	Acct 284, 285
3	Fin 350
12	Mgmt 315, 318, 370, 478
3	Mkt 340
3	Tr/Log 360
	B. Major
21	The student will take 21 credits in one of the majors: accounting, finance, management, marketing, or transportation/logistics. For the specific requirements of each major, see Index, *Business Administration.*
	C. Supportive business courses
12	To be selected by the student and adviser to support studies in the student's major.
	Electives
17	Unrestricted
124.5	**Total credits**

Bachelor of Liberal Studies

The Bachelor of Liberal Studies degree (BLS) was established in 1977 by the Iowa Regents' universities and approved by the State Board of Regents to meet the needs of thousands of Iowans who want to earn a college degree but cannot enroll in traditional on-campus study.

The BLS degree is designed specifically for those individuals with 62 semester hours or more of the college credit already earned that may be applied toward a liberal arts degree. Each of the Iowa Regents institutions can award the degree: Iowa State University, by the College of Sciences and Humanities; The University of Iowa, by the College of Liberal Arts; and the University of Northern Iowa, by the entire institution.

About three-fourths of the total degree requirements can be transferred from accredited institutions other than the one in which the student pursues the BLS degree. Work done in community colleges, private colleges or other accredited colleges out-of-state can be applied toward the degree, as can applicable courses taken at any of the three Iowa Regents' universities, whether on or off campus.

The BLS program has no residence requirements. To complete the degree, students may offer credits earned in various study formats: correspondence courses; radio, television, and newspaper courses; Saturday and evening courses; extension courses, including those with distance-learning formats such as University of Mid-America; and regular on-campus courses. Students may also earn credits by proficiency or test-out examinations.

The BLS offers an opportunity to earn a broadly based degree in the liberal arts, without a traditional major. Many groupings of courses are possible within the BLS framework. Each student's educational goals will be reviewed at the time of admission, and advisers will help applicants develop study plans that best fit their individual needs and goals.

Admission

Admission to the BLS program is open to persons who meet either of the following levels of previous educational attainment:

Hold the Associate of Arts (A.A.) or Associate of Science (A.S.) degree from an accredited two-year college. (Holders of the Associate of Applied Science or Associate of Applied Arts degree are not automatically eligible, although some courses may be found applicable upon review.)

Have at least 62 semester credits of collegiate work acceptable toward graduation at the chosen Regents' university with a total cumulative grade point average of at least 2.00 (a C average).

Requirements for the BLS Degree

A total of 124 semester credits is required for graduation. Within this total the following requirements must be met:

1. 45 semester credits must be earned at four-year colleges in courses defined as "upper level" where the credits were earned. (Upper-level courses at The University of Iowa and University of Northern Iowa are numbered 100 and above; Iowa State University upper-level courses are numbered 300 and above.)

2. 45 semester credits must be earned in courses at Iowa Regents' universities.

3. 30 semester credits must be earned after admission to the BLS program in the specific Regents' university that will grant the degree

At Iowa State University, the BLS candidate must meet the basic and general education requirements of the curriculum in sciences and humanities, College of Sciences and Humanities.

In addition to general education requirements, each student's program must include a minimum of 12 semester credits in each of three areas chosen from the following five distribution areas:
1. Humanities
2. Communications and arts
3. Natural sciences and mathematical disciplines
4. Social sciences
5. Professional fields as approved by the degree-granting institution. (Examples of professional fields are business, education, home economics.)

Lists of courses in each distribution area may be obtained from the Office of the Dean, College of Sciences and Humanities.

Of those 36 semester credits required to be earned in the three distribution areas, 24 semester credits must be in upper-level courses as defined by the institution where taken There must be at least 6 semester credits in upper-level courses in each of the three areas chosen. Moreover, the same credits may not be used to meet both general education and distribution area requirements.

A grade average of at least 2.00 (C grade) is required in all work offered for the BLS degree, in all upper-level course work, and in all work completed after admission to the BLS program

Further information may be obtained from the Office of the Dean, College of Sciences and Humanities, 204 Carver Hall, Iowa State University, Ames, Iowa 50011.

College of Veterinary Medicine

Phillip T Pearson, Dean
Durwood L. Baker, Associate Dean
William P Switzer, Associate Dean
Roger M Hogle, Assistant Dean

Departments of the College

Veterinary Anatomy
Veterinary Clinical Sciences
Veterinary Microbiology and Preventive Medicine
Veterinary Pathology
Veterinary Physiology and Pharmacology

In addition to the departments listed above, the organizational structure includes the Veterinary Medical Research Institute, the Veterinary Medical Diagnostic Laboratory, and the Biomedical Engineering Program thereby affording the student additional opportunities to observe research and diagnostic procedures.

Preveterinary students at Iowa State University usually enroll in either the College of Agriculture or in the College of Sciences and Humanities. The professional curriculum extends over a period of four years and leads to the degree Doctor of Veterinary Medicine.

Prescribed pre-professional college work, with a creditable academic average, is required for admission to the professional curriculum in veterinary medicine.

Qualified students may be concurrently enrolled in the professional curriculum leading to the D.V.M. degree and in a graduate program leading to the M.S. or Ph.D. degree after completion of at least 128 semester credits, or their quarter equivalents in preveterinary and professional curricula. Admission to the concurrent D.V.M.-graduate degree programs is subject to the approval of the dean of the College of Veterinary Medicine and the dean of the Graduate College.

Opportunities for graduates of the College of Veterinary Medicine will be found in practice, educational institutions and industry, in international agencies, federal, state, and local governments, in the armed forces, departments of public health, comparative medicine, laboratory animal medicine, and other related fields of professional activity.

Admission Requirements

Fall Semester 1982

Applicants for admission to the College of Veterinary Medicine for fall semester 1982 must fulfill the requirements listed in the 1979-81 catalog or those listed for fall semester 1983 except that all persons admitted in the fall of 1982 will need to have met the animal nutrition requirement shown below prior to admission

Fall Semester 1983

Applicants for admission to the College of Veterinary Medicine for fall semester 1983 and thereafter must have attended a regionally accredited college or university, have completed 40 semester credits prior to filing an application for admission, and have completed 60 semester credits prior to admission to the College of Veterinary Medicine. Credits earned must include the following Iowa State semester course offerings or their equivalents:

English: 9 semester credits (Engl 104, 105 and 204 or 302 or 414)

Chemistry: 20 semester credits (Chem 177, 177L, [or 163, 163L, 164,] 211, 331, 332, 333A, 334A, and B B 301)

Physics: 8 semester credits (Phys 111, 112)

Biological Sciences: 15 semester credits
- Biology (Biol 110)
- Zoology (Zool 206, 206L)
- Microbiology (Micro 300)
- Genetics (Gen 320 or 330)

Animal Nutrition: 3 semester credits (An S 218 or 319)

Credits in the previously specified courses will normally be earned on the traditional four-letter grading system with A as the highest grade and D as the lowest passing grade. However, credits earned by the credit by examination program in accordance with the regulations relating to this procedure at Iowa State University are also acceptable. Credits in the preceding specified courses will not be accepted if earned under the *Pass-Not Pass* grading system or similar options.

Applications

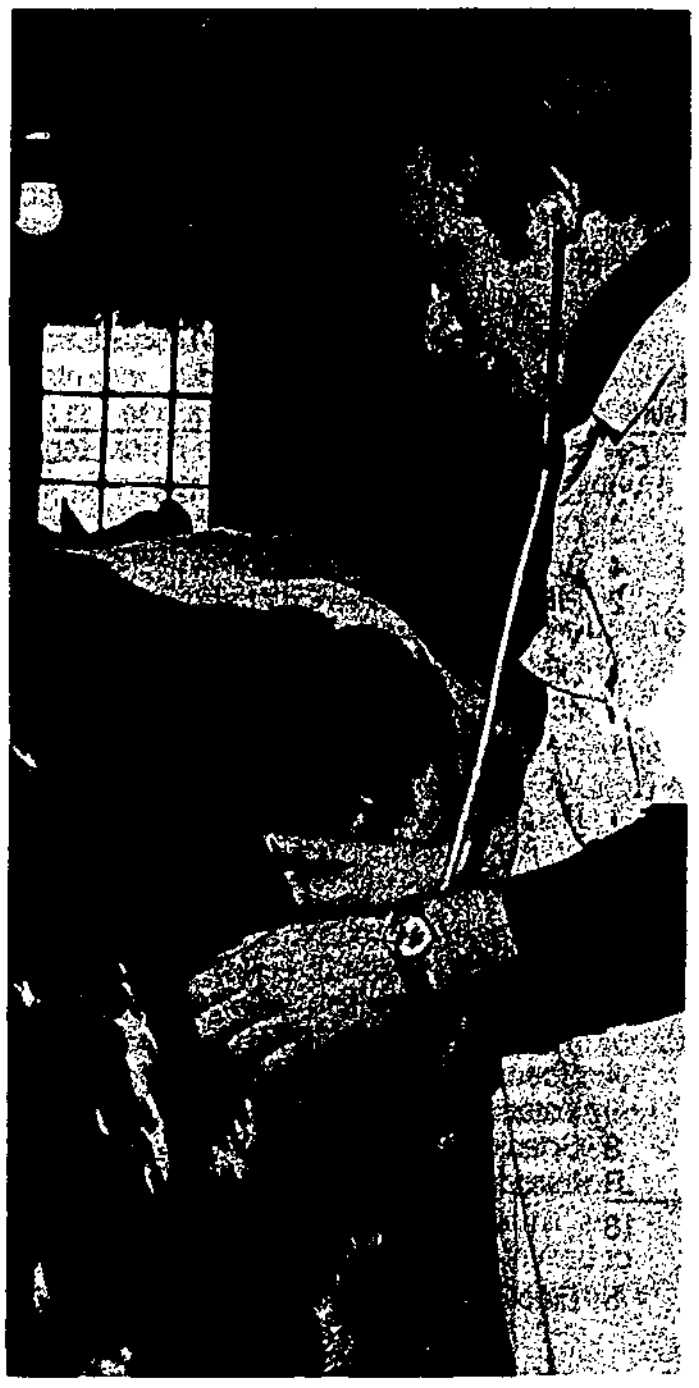
Completed applications and supporting transcripts must be received by the Iowa State University Director of Admissions (Room 7, Beardshear Hall) by December 22 of the year prior to the year in which the applicant seeks to be admitted. Transcripts of all college credits must accompany the application.

The Veterinary Aptitude Test is required of those seeking to be admitted in 1982. Students seeking admission for the fall of 1983 and thereafter must have taken the Medical College Admissions Test (MCAT). Inasmuch as the MCAT is administered semi-annually in April and September, students seeking admission for the fall of 1983 should take the MCAT in 1982.

All preveterinary requirements must be fulfilled by the time of filing or scheduled for completion by June 15 of the year in which the applicant seeks to be admitted. A list of courses in progress at the time of filing or scheduled for completion by June 15 should accompany the application and transcripts. Preprofessional college credits must average at least 2.50 on a 4.0 marking system for the application to be accepted. The preceding scholastic requirements are minimum and do not assure admission even though these requirements have been fulfilled.

Admission to the College of Veterinary Medicine is on a competitive and selective basis. Scholastic performance in preprofessional courses, aptitude, and personal development are given consideration in the selection of candidates. Since a solid foundation in the sciences is basic to success in veterinary medicine, considerable attention is given in the admission process to applicants' grades in those areas. Consideration for admission to the College of Veterinary Medicine is administered equally to all without regard to race, color, creed, sex, national origin, disability, or age Admission is granted annually at the beginning of the fall semester only, with enrollment limited to 120 students per class.

In considering applicants for admission to the College of Veterinary Medicine, preference is given to residents of Iowa and certified residents of states having contracts with Iowa State University for educating veterinary medical students.



Curriculum in Veterinary Medicine

Leading to the degree Doctor of Veterinary Medicine.

First Year

Cr.	Fall
3	Comparative Veterinary Physiology — V P P 350
9	Morphology of Domestic Animals — V An 301
4	Physiological Chemistry — B B 420
R	Professional Orientation — VM 300
16	

	Spring
5	Comparative Veterinary Physiology — V P P 351
6	Morphology of Domestic Animals — V An 302
6	Pathogenic Bacteriology and Immunology — V MPM 381
17	

Second Year

Cr.	Fall
3	Animal Virology and Mycology — V MPM 382
4	General Pharmacology — V P P 360
5	General and Systemic Pathology — V Pth 371
5	Veterinary Parasitology — V Pth 376
17	

	Spring
2	Applied Anatomy — V An 303
4	Clinical Medicine I. — V C S 394
2	Physiological Sciences Laboratory — V P P 365
1	Pharmacology and Therapeutics — V P P 361
1	Radiology — V C S 391
4	Surgery and Anesthesiology — V C S 397
3	Public Health — V MPM 384
17	
1	Electives — minimum accumulated

Third Year

Cr.	Fall
3	Clinical Pathology — V Pth 425
3	Clinical Medicine II — V C S 445
4	Special Surgery — V C S 441
2	Physiological Sciences Laboratory — V P P 366
3	Disturbances of Reproduction — V C S 450
1	Animal Reproduction Laboratory — V C S 447
1	Radiology Laboratory — V C S 448
17	

	Spring
3	Clinical Medicine III — V C S 446
5	Infectious Diseases and Preventive Medicine — V MPM 431
4	Special Pathology — V Pth 422
3	Veterinary Toxicology — V Pth 426
3	Special Surgery — V C S 449
R	Introduction to Clinics — V C S 440
18	
5	Electives — minimum accumulated

Fourth Year

Cr.	
2	Radiology — V C S 460
2	Animal Reproduction — V C S 461
4	Small Animal Medicine — V C S 462
4	Small Animal Surgery — V C S 463
4	Equine Medicine and Surgery — V C S 464
4	Veterinary Field Services — V C S 465
2	Anesthesiology — V C S 466
R	Hospital Emergency Service — V C S 467
R	Seminar — V C S 495
2	Diagnostic Laboratory — V Pth 455
1	Necropsy Laboratory — V Pth 456
1	Clinical Pathology — V Pth 457
1	Laboratory in Clinical Microbiology — V MPM 485
1	Laboratory in Public Health — V MPM 486
28	Required
12	Electives — minimum accumulated

Graduation Requirements

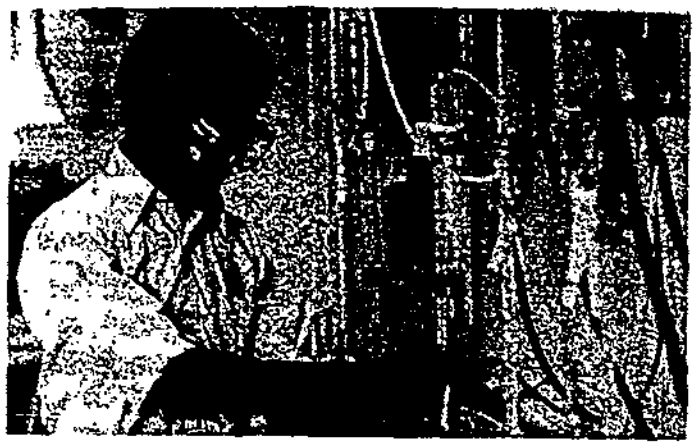
To be awarded the degree Doctor of Veterinary Medicine, candidates must have passed all required courses in the curriculum in veterinary medicine, have earned at least 12 elective credits on a graded basis of A, B, C, D, F while enrolled in the College of Veterinary Medicine, have at least a 2.0 quality-point average in the veterinary medicine curriculum, and passed the prescribed comprehensive examinations during the fourth year.

Readmission

Any student who voluntarily withdraws from the College of Veterinary Medicine or who is dropped for cause, forfeits his/her standing and must make written application for reinstatement to this college 30 or more days prior to the opening of the semester in which the student desires readmission.

Veterinary Medical Societies

All veterinary students are expected to become active members of the Iowa State Student Chapter of the American Veterinary Medical Association. The monthly meetings of the chapter serve to promote the professional and social development of the members. Students of veterinary medicine may also qualify for membership in the national honor societies of Phi Zeta, Phi Kappa Phi, Alpha Zeta, and Gamma Sigma Delta. Graduate students may qualify for membership in Sigma Xi.



Graduate College

Daniel J Zaffarano, Vice President for Research and Dean
Norman L. Jacobson, Associate Vice President for Research and Associate Dean
George G Karas, Associate Dean
Martin J. Ulmer, Associate Dean

The Graduate College at Iowa State University is responsible for the quality of graduate education, for administering students' graduate programs and for promoting research support from various governmental, industrial, and private agencies.

Members of the graduate faculty have a dual role of teaching and research. All courses offered for major or minor credit are taught by graduate faculty members. Through an advisory committee system, they supervise individual programs of study which are specially designed for each graduate student's needs.

The graduate faculty includes the president, the vice-president for academic affairs, the dean and associate deans of the Graduate College, deans and associate deans of the other seven colleges, the dean of library services, and the directors and associate directors of research institutes as full members Executive officers of departments and other members of the General Faculty may be elected to associate or full membership in recognition of accomplishments in their respective disciplines.

Graduate study was offered almost as soon as the University was founded, and the first graduate degree was conferred in 1877. Experimentation and research also started early, first in agriculture and shortly thereafter in home economics, engineering, science, and veterinary medicine. In 1913, a distinct graduate faculty was organized and an executive graduate committee appointed. In 1915, the graduate faculty held its first meeting and in 1916 it granted the first degree, Doctor of Philosophy.

Graduate education is vital to the quality of university teaching. The creative efforts of graduate faculty members and graduate students result in knowledge necessary to help society solve problems in educational, scientific, technological, and socio-economic areas. The Graduate College encourages educational exchange and contact with undergraduate areas of the University to promote improved teaching on both the undergraduate and graduate level. A part of this exchange is accomplished by books and technical articles which are made possible by graduate research.

The degrees Master of Arts, Master of Science, and Doctor of Philosophy are research oriented, although in certain fields the Master of Arts and the Master of Science degrees are also available without thesis. For those persons interested in advanced study directed more particularly toward meeting vocational or professional objectives, the degrees Master of Agriculture, Master of Architecture, Master of Community and Regional Planning, Master of Education, Master of Engineering, Master of Landscape Architecture, Master of Public Administration, and Specialist are offered.

Graduate Appointments

Graduate assistantships, fellowships, and certain special research grants have been established at Iowa State University for the encouragement of graduate work and the promotion of research. Such appointments and research opportunities are available through the various departments of instruction, the Agriculture and Home Economics Experiment Station, the Research Institute for Studies in Education, the Engineering Research Institute, the Home Economics Research Institute, the Sciences and Humanities Research Institute, the Veterinary Medical Research Institute, the Statistical Laboratory, the Computation Center, the Energy and Mineral Resources Research Institute, the Water Resources Research Institute, and the Office of the Vice President for Research.

A half-time graduate assistantship permits the holder to enroll for a maximum of 12 semester credits. Recipients of these assistantships are assessed fees at resident rates. Students who are graduates of a regionally accredited college or university in the United States or of a recognized institution in another country whose requirements for the bachelor's degree are substantially equivalent to those of Iowa State University, who graduated in the highest quartile of their respective classes and who present the requisite undergraduate or graduate preparation, may apply for these appointments. Students registered on a restricted or nondegree basis and those placed on academic probation are not eligible for assistantship appointment. Further information may be obtained by writing to the appropriate department head.

The satisfactory completion of one appointment, plus satisfactory academic performance, will ordinarily make a student eligible for reappointment. After a period of 5 years of full time study for the master's degree or 7 years for the doctorate, the student will not normally be continued on assistantship support.

Fellowships and traineeships supported by agencies of the federal government are sometimes available. Applicants for these awards must present evidence of superior scholarship. Further information may be secured by writing to the dean of the Graduate College.

MASUA Traveling Scholar Program

As a member of the Mid-America State Universities Association, Iowa State University participates in the MASUA Traveling Scholar Program. Universities cooperating include Iowa State University; University of Kansas; Kansas State University; University of Missouri at Columbia, Kansas City, Rolla and St. Louis; University of Nebraska; University of Oklahoma; and Oklahoma State University

The MASUA Traveling Scholar Program is designed to provide breadth and depth in the opportunities for graduate study offered at MASUA universities by permitting advanced graduate students to study at another MASUA university where they may utilize unique facilities or specializations.

Graduate students at MASUA universities are eligible to participate in this program for a minimum of one term of enrollment. The student's major adviser initiates the proposal for the student's participation by contacting the professor at another MASUA university where the student wishes to study. The graduate dean at each university involved must concur in proposed participation. During the time of participation, the student will register for research or special topics credit for the appropriate number of hours and pay fees at the home university. Graduate students chosen to participate in the program will be provided $100 for travel and a stipend of $50 monthly for a minimum of three months (payable from MASUA funds upon return to the home institution). Additional information concerning the MASUA Traveling Scholarship Program is available at the Graduate Office.

Postdoctoral Study

Opportunities are provided for postdoctoral study through the extensive research programs of the University. Inquiries should be directed to the appropriate department, institute, or to the dean of the Graduate College.

Graduate Study by Members of the Staff

Any full-time member of the research, instructional, or extension staffs of the rank of instructor, subject to the approval of the head of his or her department or section, may carry not more than 6 semester credits of graduate work per semester, provided such does not interfere with other duties. This privilege may be extended to members of the research, instructional, or extension staffs of the rank of assistant professor upon approval of the dean of the employee's college and the dean of the Graduate College.

Staff members holding the rank of professor or associate professor cannot become candidates for degrees from this institution.

Admission

Admission to the Graduate College may be granted to a graduate of an institution in the United States which is accredited by a recognized regional association or to a graduate of a recognized institution in another country whose requirements for the bachelor's degree are substantially equivalent to those of Iowa State University. For information concerning graduate study in a particular academic discipline, a prospective student is invited to correspond with the head of the department in which he or she wishes to study.

Application forms are available from the Office of Admissions, 7 Beardshear Hall. These forms, together with official transcripts and statement of quartile rank, should be forwarded to the Office of Admissions at least one month prior to the opening of the semester when the student wishes to matriculate. An application fee of $10 is charged each applicant formally applying for admission to the Graduate College. If the undergraduate degree is from Iowa State University or if the student is applying for nondegree admission, no application fee is assessed.

Graduate Record Examination. The Graduate Record Examination (GRE) is not a university-wide requirement for all applicants However, some departments require or recommend submission of GRE scores; individual departmental statements appearing later in this catalog should be consulted for this information.

Full Admission. An applicant who is a graduate of a regionally accredited institution in the United States or of a recognized institution in another country whose requirements for the bachelor's degree are substantially equivalent to those of Iowa State University, and who ranks in the upper one-half of his or her class, may be admitted to the Graduate College, if recommended by the department and approved by the dean of the Graduate College. Admission does not constitute acceptance as a candidate for a degree.

Provisional Admission. An applicant who is a graduate of a regionally accredited college or university in the United States or of a recognized institution in another country, whose requirements for the bachelor's degree are substantially equivalent to those at Iowa State University, and who ranks in the upper one-half of his/her class, but who has certain background deficiencies to remedy, may be admitted to the Graduate College on provisional admission if recommended by the department and approved by the dean of the Graduate College. Students accepted on provisional admission are eligible to apply for graduate assistantships. Transfer from provisional admission to full admission requires recommendation of the major professor and approval by the Graduate College.

Restricted Admission may be granted to persons who are graduates of regionally accredited universities or colleges of the United States but who do not rank in the upper one-half of their class, and to graduates of recognized foreign institutions. This status requires the recommendation of the major department and approval of the dean of the Graduate College. Transfer from restricted to full admission usually requires completion of at least 10 semester hours of graduate level courses with a grade average of B or above. The recommendation must be submitted by the student's major professor and approved by the dean of the Graduate College.

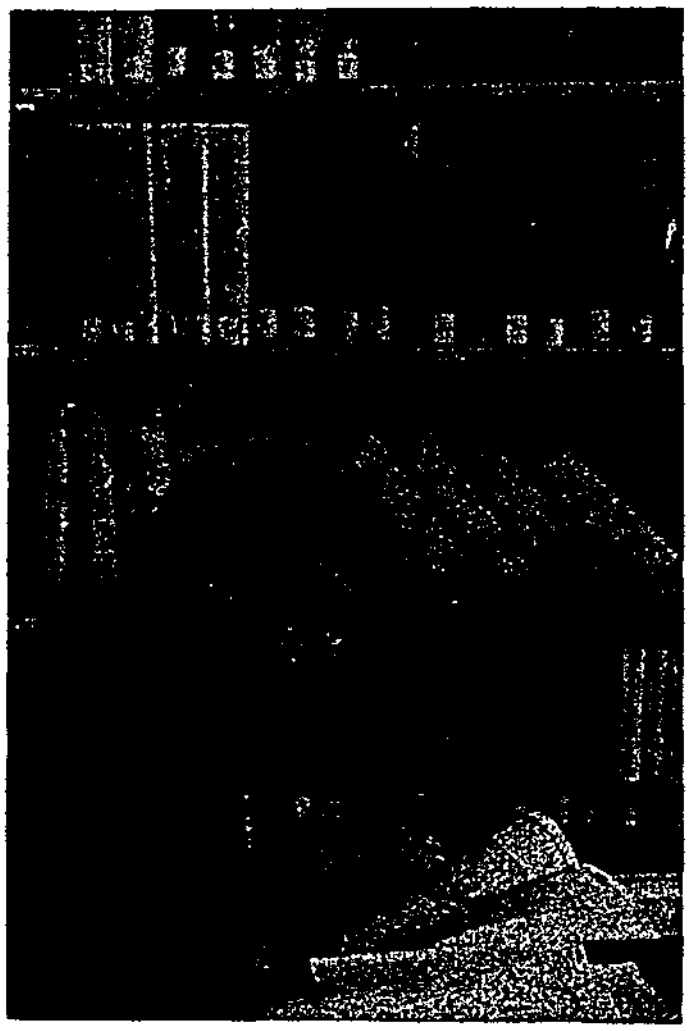
Nondegree Admission. A graduate of a regionally accredited university or college in the United States may be granted nondegree admission: (1) to take course work for subsequent transfer to other institutions; (2) to enroll occasionally in off-campus graduate courses; or (3) to take graduate courses without pursuing an advanced degree program.

Transfer from nondegree admission to full admission requires submission of complete academic records, recommendation by the department head and the approval of the graduate dean, and payment of an application fee of $10 by those who do not have an undergraduate degree from Iowa State University

For those students admitted to the Graduate College for nondegree study, no more than 9 semester hours of graduate credit earned under the non-degree option may be applied if the student later chooses to undertake a degree option. The student's advisory committee will recommend which courses, if any, taken on a nondegree basis may be included in the program of study.

Medical Examination

New students will be sent a medical history form with their letter of admission. This form must be completed and on file at the Student Health Service before a student can be treated by a physican there. All records are confidential. Student records are not available without the student's permission. A copy of the record may be sent to a physician of the student's choice.



English Requirement

The status of all graduate students whose native language is English is determined at the time of admission. Students who fall into one of the following categories have fulfilled the English requirement: 1) have completed an undergraduate English composition sequence with a B average or better; 2) have passed, as an undergraduate, an English examination which tests the ability to communicate in writing (similar to the ISU Graduate English Examination); and 3) have written in the English language a master's thesis which has been accepted by a regionally accredited college or university; or 4) have passed the Graduate English Examination as specified by the major department. Individual departments may establish more stringent requirements. The departments of Chemistry, Earth Sciences, Physical Education and Veterinary Pathology require their students to satisfy the requirement by taking the Graduate English Examination.

Students (except those admitted on a nondegree basis) who are required to take the Graduate English Examination should do so before completing 12 credit hours of graduate work at Iowa State University.

Foreign Students

An applicant who is a graduate of a recognized foreign institution is subject to the same criteria for admission as a graduate from an institution in the United States and may be recommended for the same admission categories described above. The *admission* deadline for international students is one month prior to the first day of classes for each semester.

A graduate student whose native language is not English must take a special English placement examination administered by the Department of English in lieu of the standard qualifying examination.

Students registered on a restricted or nondegree admission basis and those placed on probation are not eligible for assistantship appointment.

Foreign students are required to carry adequate health and accident insurance while in residence.

Registration

Planning Graduate Study. Scholastic competence, independence and maturity of thought should have dominance over other objectives of graduate study. Students must accept responsibility for their own education and should recognize that excessive emphasis on course work will not leave time to explore and master aspects of learning which will give them confidence in their own judgments. As soon as possible, in conference with the head of the department, the student should select a major professor and advisory committee and in consultation with them outline a program of study.

Residence Registration. Classification in courses carrying full graduate credit is limited to a maximum of 15 credits per semester: Schedules for graduate assistants on one-half time appointments are limited to a maximum of 12 credits. For full-time staff members, the limit is 6 credits.

Even though course and residence requirements have been met graduate students must register in any semester in which the facilities of the institution or staff time are being used, including library borrowing privileges and preparation of thesis or dissertation, or preparation for examination. The student must be registered during the semester in which the preliminary and final examinations are held

Interim Registration. Registration for special work between semesters and during certain vacation periods cannot exceed 1 credit for each week that the student is in residence.

"In Absentia" Registration. Graduate work by correspondence is not permitted, nor is it accepted in transfer. In absentia registration is restricted to thesis preparation after completion of research or for research under special conditions. The total credit thus obtained cannot be used to reduce residence requirements.

Extension and Off-campus Registration. Many departments offer off-campus classes taught by members of the university graduate staff. For this puporse special arrangements are made for the necessary library and laboratory resources so that the classes are equivalent to those taught on campus.

Continuing Registration Policy. Graduate students who pass the oral preliminary examination for the Ph.D. degree and leave the Ames campus for one or more semesters before receiving their degrees must pay an "R" fee

each semester for maintenance of their records each semester they are absent and are not using university facilities or faculty time. This fee must be continued each semester excluding summer term.

Students who have passed the preliminary oral examination and are using university facilities and/or faculty time must register each semester for an appropriate number of credit hours and must pay resident or nonresident fees, in accordance with their residency status, regardless of being primarily on campus or off campus.

Auditing. Courses may be audited upon recommendation of the student's major professor. Each audited course will reduce the permitted credit load by one, but fees will be assessed on the basis of the credit hours of the course.

Graduate Courses Taken by Seniors. Certain graduate level courses listed in the *General Catalog* may be taken for graduate credit by undergraduate seniors at Iowa State University. If a student is admitted for graduate study at Iowa State University, the advisory committee at the time the program of study is submitted may request approval from the graduate dean that up to 9 semester hours of such credit be applied toward meeting advanced degree requirements Credits earned in these courses must be in addition to those used to meet requirements for the bachelor's degree

Special Regulations for Students in Veterinary Medicine. Specially qualified advanced students in veterinary medicine may request permission from the dean of the College of Veterinary Medicine and the dean of the Graduate College to pursue work coincidentally toward the degrees Master of Science or Doctor of Philosophy and Doctor of Veterinary Medicine.

To participate in such a concurrent program, a student must be admitted to the Graduate College and an advisory committee must be appointed according to the usual procedures. A program of study must be submitted to the Graduate College and the College of Veterinary Medicine for approval.

Degree Requirements

A *Graduate Student Handbook* is available in the Graduate Office Each new graduate student is urged to obtain a copy A *Graduate Faculty Handbook*, listing policies and procedures of the Graduate College, is also available to all staff members and may be obtained at the Graduate Office.

Probation. To remain in good standing, a student must maintain an average of B on all work taken in the Graduate College (exclusive of research credits) A student may be placed on probation for failure to meet scholastic requirements. Removal from probation is accomplished upon specific recommendation from the student's major professor to the Graduate College. Students will not be admitted to candidacy while on probation. Generally registration beyond the second semester will be refused to a student whose quality of work is unsatisfactory.

Time Limit. It is expected that work for the master's degree shall be completed within five years. A student beginning a Ph.D. degree program at Iowa State with a master's degree is expected to complete the Ph.D. within five years, while a student beginning a Ph.D. degree program without the master's degree is expected to complete the program within seven years. In special circumstances the student's advisory committee may recommend that the graduate dean extend these degree time limits. Cases in which the student leaves Iowa State during his or her graduate career and later returns are dealt with individually by the student's advisory committee and the Graduate Office.

Master of Science and Master of Arts

A student on full admission becomes eligible for candidacy after completing one semester's work with a B average. General requirements for the degree are as follows:

Appointment of the Student's Advisory Committee. As soon as praticable after the student enrolls in the Graduate College, the department head or chairman shall recommend to the dean of the Graduate College a committee of the graduate faculty to be in charge of the student's work.

This committee shall consist of at least three members of the graduate faculty, one of whom must be from a department other than that in which the student is enrolled. At least one member of the committee should be a full member of the graduate faculty. An associate member of the graduate faculty may serve as a major professor for a master's degree candidate. A faculty member holding a joint appointment may not serve as an "outside the department" member on a committee if the student's major is in either of the departments represented in the joint appointment.

Program of Study. A program of study, developed by the student and major professor in consultation with the program of study committee should be submitted for approval by the end of the second semester in residence

Residence. There is no on-campus residence requirement for the master's degree.

Credits. At least 30 credits of acceptable graduate work must be completed, not less than 22 of which must be earned from this institution.

Any transfer of credits from another institution must be recommended in the program of study by the student's program of study committee. Graduate credit will be approved for transfer only if it is of B grade or better.

Major. The exact number of credits in a major is not prescribed. To obtain the specialization which is considered essential for an advanced degree, approximately two-thirds of the work should be devoted to the major field, but this is not necessarily restricted to one department. A formal minor may be declared but will require approval by the minor department.

A graduate student may not change from one department to another without written permission from the heads of departments involved, and approval of the dean of the Graduate College.

Foreign Languages. There is no uniform language requirement for the Graduate College. Please see the departmental descriptions in this catalog for specific departmental requirements.

For those departments wishing to utilize them and for students interested in transferring a foreign language test score elsewhere, the University offers the standardized examinations provided by Educational Testing Service.

For students whose native language is not English, the ability to communicate adequately in English (certified by the Department of English) may be acceptable as a substitute for the reading knowledge of one foreign language. This option will apply only when specifically recommended by the student's program of study committee.

The foreign language requirements, where applicable, must be met before the semester in which the student will receive the degree.

Application for Graduation. Application for graduation must be made by midterm of the semester preceding the semester in which the student expects to receive the degree. This requires the presentation of an approved diploma slip to the Office of the Graduate Dean.

Thesis. A thesis is required in all areas in which the M.S. or M.A. is granted, except where specific provision is made for a nonthesis degree program. Joint authorship is not permitted. Copies of the completed thesis must be in the hands of the examining committee and the Thesis Office for approval two weeks prior to the date fixed for the final examination. After the final examination, two unbound approved copies of the thesis shall be deposited with the Thesis Office, 213 Beardshear Hall. These copies of the thesis must be deposited not less than two weeks prior to commencement. A charge of $30 will be made to cover library costs and title publication in *Iowa State Journal of Research.*

The student should consult *The Graduate College Thesis Manual* for instructions about thesis preparation and time schedules.

Final Examination. After all other requirements have been met, the final examination shall be taken over all graduate work, including the thesis where applicable. It will be oral, but may be written in part if specified by the committee in charge.

Graduation Approval Slip. This slip is prepared by the Office of Student Records about two weeks before the end of a semester. Candidates wishing to secure this form at any earlier date should file a request with the Graduate Office at least three days prior to the time the form is needed.

Master of Science and Master of Arts — Nonthesis

In certain departments a nonthesis degree program may be undertaken. This will require satisfactory completion of at least 30 credit hours of acceptable work (not including research credit) and satisfactory completion of a comprehensive examination. Every nonthesis master's program, however, must present substantial evidence of individual accomplishment which may vary from a special report, for example, or an annotated bibliography to a project in research, design, or other creative endeavor. A minimum of three hours of such independent work is required on every program of study for a nonthesis master's degree. This element of creative independent study shall be explicitly identified on the program of study. Detailed requirements may vary with fields. Reference should be made to the departmental descriptions in this catalog.

Master of Agriculture

The major in professional agriculture is an off-campus, non-thesis program leading to the degree Master of Agriculture. It is available to students wishing to pursue graduate study in agriculture without taking formal course work on campus. The program is considered to be a terminal master's degree. Students are required to take a minimum of two courses in each of three disciplines and complete 24 semester credits of formal course work. Courses are offered in Agricultural Mechanization, Agronomy, Animal Science and Economics. A minimum of four credits of creative component experience is required. Four workshops of one credit each are also required.

Master of Architecture

The Department of Architecture offers several programs leading to the degree Master of Architecture, a professional degree. Beyond the degree Bachelor of Agriculture, a minimum of 30 graduate credits is required. Beyond the degrees B.A. or B.S. in architecture or environmental design, a minimum of 60 credits is required. For students with other baccalaureate degrees, a program of more than 60 credits will be tailored to each student's experience, training, and education. For programs of 60 credits or more, 40 of these credits must be graduate credits.

Master of Community and Regional Planning

The degree Master of Community and Regional Planning requires 52 semester hour credits, including a 9 credit thesis.

Master of Education

For the degree master of education, a minimum of 30 credits of graduate level courses will be required. A creative component is required in which the student demonstrates an ability to perform creative, independent study.

Master of Engineering

The academic standards and the general level of attainment are the same for the Master of Engineering and Master of Science degrees. Master of Engineering programs are offered to meet the needs for professionally oriented programs on campus, and for off-campus professionally oriented programs at locations with adequate library and laboratory facilities.

An appropriate number of credit hours in design, laboratory work, computation or independent study is required as evidence of individual accomplishment.

Of the minimum credit requirement of 30, 22 credits must be received from Iowa State University.

Master of Landscape Architecture

The degree Master of Landscape Architecture requires a minimum of 40 graduate credits and the satisfactory completion of a thesis or a terminal project.

Master of Public Administration

This is a professional degree program designed to provide training necessary for an administrator in a public or quasi-public bureaucracy. A minimum of 39 semester credit hours is required in six subject areas. Either an internship in a governmental unit or a thesis is required.

Specialist

This degree is a post-master's degree in school psychology requiring 60 hours of work beyond the baccalaureate. It requires a thesis equivalent to a master's thesis, and an internship in the public schools of not less than 600 clock hours.

Doctor of Philosophy

The degree Doctor of Philosophy is strongly research oriented. The primary requirements for the degree are: 1) high attainment and proficiency of the candidate in his or her chosen field, (2) development of a dissertation which is a significant contribution to knowledge and which shows independent and creative thought and work, and (3) successful passing of detailed examinations over the field of the candidate's major work, with a satisfactory showing of preparation in related courses.

Appointment of the Student's Program of Study Committee. As soon as practical after the student enrolls in the Graduate College, the department head or chair shall recommend to the dean of the Graduate College a committee of the graduate faculty to be in charge of the student's graduate program. This committee shall consist of at least five members of the graduate faculty, three of whom must be full members. At least two committee members must be outside the declared major or area of specialization, and at least one of these must be outside the major department. A faculty member holding a joint appointment may not serve as an "outside the department" member on a committee if the student's major is in either of the departments represented in the joint appointment. An associate member of the graduate faculty may not serve as a major professor of a doctoral program but may co-chair a doctoral committee.

Program of Study. A program of study should be developed by the student in consultation with his or her major professor and committee. This should be submitted for approval by the end of the second semester in residence.

Residence. A minimum of 72 graduate credits must be earned for a Ph.D. degree. At least 36 credits including all dissertation research credits must be earned under the supervision of the student's program of study committee. Graduate credits of B grade or better earned at another institution may be transferred at the discretion of the program of study committee and the approval of the department and Graduate College. Transfer of S and "pass" grades may be accepted for research only when such grades can be documented as being B grade or better. Responsibility for submitting such documentation to the Graduate College rests with the student's program of study committee.

At least 24 credits must be earned during two consecutive semesters while in residence at the University.

Major and Minor. A major is the area of study or academic concentration in which a student chooses to qualify for the award of a graduate degree. Majors are listed for departments and interdepartmental programs in the *Courses and Programs* section of the catalog.

To avoid overspecialization, a significant body of pertinent course work must be taken outside of the major field. The work outside the major field should amount to approximately 12 hours of applicable graduate credit as required by the student's committee.

Opportunities also exist for majoring in more than one area of study (co-major or joint-major programs).

Courses for minor credit are listed by departments or interdepartmental programs. *(See Courses and Programs.)* Formal minors may be declared, in which case the student must meet certain minimum requirements established by the department administering the minor.

Foreign Languages. The Graduate College has no uniform requirements. Foreign language requirements for those departments having them are specified in the individual department descriptions in the *Courses and Programs* section of this catalog.

For those departments wishing to use them and for students interested in transferring a foreign language test score elsewhere, the University offers the standardized examinations provided by the Educational Testing Service.

For students whose native language is not English, the ability to communicate adequately in English (certified by the Department of English) may be acceptable as a substitute for the reading knowledge of one foreign language This option will apply only when specifically recommended by the student's program of study committee.

The foreign language requirement, when applicable, may be fulfilled at any time, but not less than six months prior to the final examination.

Preliminary Examination. The student must pass satisfactorily a preliminary examination before being granted advancement to candidacy for the degree. This examination is comprehensive and should not be restricted only to the content of graduate courses. It usually has two parts: a written examination followed by an oral examination. The oral examination is mandatory, and all members of the student's doctoral committee (or approved substitutes) must be present. The preliminary examination is usually given before all course work has been completed, and must be passed at least six months before the final examination. Exceptions to this rule will be made only upon special recommendation of the student's committee and approval of the graduate dean.

Diploma Slip. A diploma slip must be filled out and returned by mid-term of the semester preceding the semester in which the student expects to receive the degree.

Dissertation. A doctoral dissertation shall be completed on some topic connected with the major field. To be acceptable, it must constitute a significant contribution to knowledge. Joint authorship is not permitted.

Copies of the completed dissertation must be in the hands of the examining committee and the Thesis Office for approval two weeks prior to the date fixed for the final examination. After the examination, and at least two weeks prior to commencement, two complete and approved copies of the dissertation shall be deposited with the Thesis Office, 213 Beardshear Hall.

At the same time the dissertation is deposited, two typewritten copies of an abstract which meet the requirements as set forth in *The Graduate College Thesis Manual* must also be filed with the Thesis Office, 213 Beardshear. A charge of $60 will be made to cover costs, microfilming of the dissertation, and publication of a 600-word abstract in *Dissertation Abstracts* The abstract should cover the entire dissertation and should not be considered as excluding publication of a journal article.

Final Examination. A final examination shall be taken after submission of the dissertation and the completion of all other work prescribed for the degree. This examination shall be oral; it may be both written and oral if specified by the student's committee. It is intended principally as a defense of the dissertation.

Graduation Approval Slip. These slips are prepared by the Office of Student Records about two weeks prior to the end of a semester. Candidates wishing to secure this form at any earlier date should file a request with the Office of the Graduate Dean at least three days prior to the time the form is needed.

Summary of Graduate Degrees, Majors and Areas of Specialization*

Aerospace Engineering — M. Eng., M.S., Ph.D. — Aerospace Engineering.

Agricultural Education — M.S., Ph.D. — Agricultural Education.

Agricultural Engineering — M. Eng., M.S., Ph.D. — Agricultural Engineering, Agricultural Mechanization (minor only), *Soil and Water Resources, Agricultural Power and Machinery, Electric Power and Processing, Agricultural Structures and Environment, Animal Waste Management.*

Agronomy — M.S., Ph.D. — Agricultural Climatology, Crop Production and Physiology, Plant Breeding and Cytogenetics, Soil Chemistry, Soil Fertility, Soil Management, Soil Microbiology and Biochemistry, Soil Morphology and Genesis, Soil Physics.

Animal Ecology — M.S., Ph.D. — Animal Ecology, *Animal Behavior, Ecology, Taxonomy, Limnology;* Fisheries Biology, *Animal Behavior, Ecology, Limnology, Taxonomy;* Wildlife Biology, *Animal Behavior, Ecology, Taxonomy, Limnology.*

Animal Science — M.S., Ph.D. — Animal Breeding, Animal Nutrition, Animal Production (M S only), Meat Science, Muscle Biology, Nutritional Physiology, Physiology of Reproduction, Poultry Nutrition, Poultry Products Technology.

Anthropology — See Sociology.

Architecture — M. Arch. — Architecture

Art and Design — M.A. — Art and Design, *Advertising Design, Art Education, Craft Design, Interior Design.*

Biochemistry and Biophysics — M.S., Ph.D. — Biochemistry, Biophysics.

Biomedical Engineering (Interdepartmental Program) — M.S., Ph.D. — Biomedical Engineering.

Botany — M.S., Ph.D. — Botany, *Aquatic Plant Biology, Cytology, Ecology, Economic Botany, Morphology, Mycology, Physiology, Taxonomy.*

Chemical Engineering — M. Eng., M.S., Ph.D., — Chemical Engineering.

Chemistry — M.S., Ph.D., — Analytical Chemistry, Chemistry. *Inorganic-Organic* (Ph.D. only), *Physical-Inorganic* (Ph.D. only), *Analytical-Physical, Organic-Analytical* (Ph D only), Inorganic Chemistry (Ph.D. only), Organic Chemistry, Physical Chemistry.

Child Development — M.S., Ph.D. — Child Developrnent.

Civil Engineering — M.S., Ph.D. — Civil Engineering (M.S. only), Geodesy and Photogrammetry (M.S. only), Municipal Engineering (M.S. only), Sanitary Engineering, Geotechnical Engineering, Structural Engineering, Transportation Engineering.

Community and Regional Planning — M.C.R.P. — Community and Regional Planning.

Computer Science — M.S., Ph.D. — Computer Science.

*Areas of specialization are shown in italics.

Earth Sciences — M.S., Ph.D. — Earth Science, Geology, Meteorology.

Economics — M.S., Ph.D. — Agricultural Economics, Economics.

Education — See Professional Studies.

Electrical Engineering — M. Eng., M.S., Ph.D. — Electrical Engineering, *Electromagnetics* (Ph.D. only), *Computer Engineering* (Ph.D. only), *Control Systems* (Ph.D. only), *Electric Power* (Ph.D. only).

Energy Systems Engineering — Interdepartmental minor only.

Engineering Science and Mechanics — M. Eng., M.S., Ph.D. — Engineering Mechanics.

English — M.A. — English.

Entomology — M.S., Ph.D. Entomology, *Behavior, Biological Control, Ecology, Economic Entomology, Medical Entomology, Host Plant Resistance, Morphology, Pathology, Pest Management, Physiology, Systematics, Insecticide Toxicology.*

Family Environment — M.S., Ph.D. (joint major) — Family Environment.

Food and Nutrition — M.S., Ph.D. — Food and Nutrition (M.S. only), Food Science, Nutrition.

Food Technology — M.S., Ph.D. — Food Technology, Meat Science (joint major).

Forestry — M.S., Ph.D. — Forestry, *Administration and Management* (M.S. only), *Biology* (M.S. only), *Biometry, Economics and Marketing* (M.S. only), *Wood Science* (M.S. only), *Forest Economics* (Ph.D. only), *Biology — Wood Science* (Ph.D. only).

General Graduate Studies (Interdepartmental Program) — M.A., M.S., — General Graduate Studies, *Arts and Humanities, Biological Sciences, Physical Sciences, Social Sciences.*

Genetics — M.S., Ph.D. — Genetics.

Gerontology — Interdepartmental minor only.

History — M.A., Ph.D. — History (M.A. only), History of Technology and Science.

Home Economics Education — M.Ed., M.S., Ph.D. — Home Economics Education.

Horticulture — M.S., Ph.D. — Horticulture.

Housing — Interdepartmental minor only.

Immunobiology (Interdepartmental Program) — M.S., Ph.D. — Immunobiology.

Industrial Administrative Sciences (Interdepartmental Program) — M.S. — Industrial Administrative Sciences.

Industrial Education — M.Ed., M.S., Ph.D. — Industrial Education, *Industrial Arts, Industrial Vocational-Technical Education, Occupational and Traffic Safety Education.*

Industrial Engineering — M. Eng., M.S., Ph.D. — Engineering Valuation, Industrial Engineering (M Eng., M.S. only), *Operations Research* (co-specialization, M.S. only)

Industrial Relations (Interdepartmental Program) — M.S. — Industrial Relations.

Institution Management — M.S., Ph.D. (joint major) — Institution Management.

Journalism and Mass Communication — M.S. — Journalism and Mass Communication

Landscape Architecture — M.L.A. — Landscape Architecture

Materials Science and Engineering — M.Eng., M.S., Ph.D. — Materials Science and Engineering (M Eng only), Ceramic Engineering, Metallurgy, *Chemical Metallurgy, Mechanical Metallurgy, Physical Metallurgy.*

Mathematics — M.S., Ph.D. — Applied Mathematics, Mathematics

Mechanical Engineering — M.S., Ph.D. — Mechanical Engineering

Microbiology — M.S., Ph.D. — Microbiology, *Applied, Food, Medical, Systematic Microbiology, Immunology, Microbial Ecology, Genetics, Morphology, Physiology, Virology.*

Molecular, Cellular, and Developmental Biology — Interdepartmental major only

Nuclear Engineering — M. Eng., M.S., Ph.D., — Nuclear Engineering.

Physical Education — M.S. — Physical Education

Physics — M.S., Ph.D. — Astrophysics, High Energy Physics, Nuclear Physics, Physics, Solid State Physics.

Plant Pathology, Seed and Weed Sciences — M.S., Ph.D. — Plant Pathology, *Seed Science, Weed Science.*

Political Science — M.A., M.P.A. — Political Science, Public Administration

Professional Agriculture — M.Agric. — Professional Agriculture.

Professional Studies in Education — M.Ed., M.S., Ph.D. — Education; *Adult and Extension Education; Curriculum and Instructional Media; Educational Administration; Elementary Education* (M.S. only); *Counselor Education; Higher Education; History, Philosophy, and Comparative Education; Learning Disabilities* (M.S. only); *Research and Evaluation.*

Psychology — M.S., Sp., Ph.D. — Psychology, School Psychology (Sp. only).

Sociology and Anthropology — M.A., M.S., Ph.D. — Rural Sociology, Sociology, *Anthropology* (M.A. only).

Statistics — M.S., Ph.D. — Statistics, *Applied Statistics, Experimental Design, Statistical Methods, Operations Research (co-specialization, M.S. only), Probability, Statistical Computing, Statistical Theory, Survey Sampling.*

Technology and Social Change — Interdepartmental minor only.

Textiles and Clothing — M.S. — Textiles and Clothing

Transportation Planning — Interdepartmental major only

Veterinary Anatomy — M.S., Ph.D. — Veterinary Anatomy

Veterinary Clinical Sciences — M.S. — Veterinary Clinical Science, *Veterinary Radiology, Theriogenology, Veterinary Surgery, Veterinary Medicine.*

Veterinary Microbiology and Preventive Medicine — M.S., Ph.D. — Veterinary Microbiology, Veterinary Preventive Medicine (M S only)

Veterinary Pathology — M.S., Ph.D. — Veterinary Pathology, *Veterinary Parasitology, Veterinary Toxicology.*

Veterinary Physiology and Pharmacology — M.S., Ph.D. — Veterinary Physiology, *Pharmacology.*

Water Resources — Interdepartmental major only.

Zoology — M.S., Ph.D. — Zoology, *Animal Behavior, Cellular Biology; Comparative Physiology; Ecology; Endocrinology, Immunobiology; Cellular, Molecular and Developmental Biology; Neurobiology, Parasitology, Physiology*

Interdepartmental Offerings and Cooperating Departments

Interdepartmental Programs

Biomedical Engineering — College of Engineering, College of Veterinary Medicine

General Graduate Studies — all departments offering graduate courses

Immunobiology — Agronomy, Animal Science, Biochemistry and Biophysics, Food and Nutrition, Genetics, Microbiology, Veterinary Microbiology and Preventive Medicine, Veterinary Pathology, and Zoology

Industrial Administrative Sciences — Business Administration, Economics, Industrial Engineering, Statistics.

Industrial Relations — Economics, Industrial Engineering, Political Science, Psychology, Sociology

Interdepartmental Majors

Molecular, Cellular, and Developmental Biology — Agronomy, Animal Science, Biochemistry and Biophysics, Botany, Food Technology, Genetics, Microbiology, and Zoology.

Transportation Planning — Business Administration, Civil Engineering, Community and Regional Planning, Economics, Industrial Engineering, Political Science, and Sociology.

Water Resources — Agricultural Engineering, Agronomy, Animal Ecology, Botany, Chemical Engineering, Civil Engineering, Earth Sciences, Economics, Family Environment, Food and Nutrition, Food Technology, Forestry, Horticulture, Industrial Engineering, Microbiology, Nuclear Engineering, Political Science, and Sociology.

Interdepartmental Minors

Energy Systems Engineering — Aerospace Engineering, Agricultural Engineering, Architecture, Chemical Engineering, Civil Engineering, Electrical Engineering, Engineering Science and Mechanics, Industrial Engineering, Materials Science and Engineering, Mechanical Engineering, and Nuclear Engineering.

Gerontology — Architecture, Biochemistry and Biophysics, Business Administration, Economics, Family Environment, Food and Nutrition, Home Economics Education, Political Science, Professional Studies in Education, Psychology, Sociology and Anthropology, Speech, Textiles and Clothing

Housing — Architecture, Art and Design, Community and Regional Planning, Family Environment, Landscape Architecture

Technology and Social Change — Aerospace Engineering, Agricultural Engineering, Agronomy, Animal Science, Chemical Engineering, Chemistry, Civil Engineering, Community and Regional Planning, Computer Science, Earth Sciences, Economics, Electrical Engineering, English, Family Environment, Food and Nutrition, History, Industrial Education, Industrial Engineering, Journalism and Mass Communication, Materials Science and Engineering, Mechanical Engineering, Nuclear Engineering, Physics, Philosophy, Political Science, Professional Studies in Education, Sociology and Anthropology, Textiles and Clothing.

Courses and Programs

Information About Courses

Course Numbers

The courses in each department are numbered from 1 to 699, according to the following groups:

1- 99 — Courses not carrying credit toward a degree.
100-299 — Courses primarily for freshman and sophomore students.
300-499 — Courses primarily for junior and senior students.
500-599 — Courses primarily for graduate students, but open to qualified undergraduates.
600-699 — Courses for graduate students only.

Credits and Contact Hours

The academic value of each course is stated in semester credits. Each credit is normally earned by attending one (50-minute) hour of lecture or recitation per week for the entire semester, or by attending a laboratory or studio period of two or three hours per week. In addition, undergraduate students typically will be expected to spend two hours in preparation outside of class for each lecture or recitation hour; additional outside work may be required for laboratory or studio classes.

Each course states the number of semester credits assigned to the course, preceded in parentheses by the number of hours in class (contact hours) expected of the student. The first of the two contact-hour numbers indicates the number of lecture or recitation class hours per week for the semester. The second is the number of laboratory or studio hours required per week.

The term "Cr. arr." means that the amount of credit is arranged in advance between the student and the instructor. The credit to be earned depends on the amount of work expected of the student, in accordance with the policy that some combination of teacher-student contact and outside work by the student involving at least three hours per week for the entire semester is required for each credit.

The term "Cr. R." means that the course is required in a certain curriculum, but no credit is given.

Semester of Offering

Within each course description may be found one or more of the following letters: F. S. SS., indicating which term — fall, spring, summer session — of the academic year the course is offered. "Alt." is the abbreviation for alternate The abbreviation "Yr." is used to designate a sequence of two courses taught fall and spring, respectively. If there is sufficient demand, courses may be offered more frequently than announced.

Course Prerequisite

A prerequisite indicates the specific academic background, or general academic maturity, considered necessary for the student to be ready to undertake the course. Prerequisites are usually stated in terms of specific courses, but equivalent preparation is usually acceptable. An instructor may, however, direct a student whose background does not meet the stated prerequisite, or its equivalent, to drop the course. Conversely, an instructor may waive the prerequisite for a course for which he or she is responsible Thus, permission of the instructor is understood to be an alternate to the stated prerequisites in all courses.

Designators

For a list of abbreviations designating departments and programs, see page 29

Graduate Programs

Graduate Major

A major in the Graduate College is the area of academic professional concentration, approved by the Board of Regents, in which the student chooses to qualify for the award of a graduate degree

Graduate Area of Specialization

Areas of specialization are indicated in the graduate statements of some departments. This is a subdivision of a major in which a strong graduate level program is available. When approved by the Graduate College, such areas of specialization are shown parenthetically after the major on official records and transcripts.

Interdepartmental Programs

Interdepartmental programs are available at both graduate and undergraduate levels. An interdepartmental program is an administrative structure usually not functioning as a department, ordinarily headed by an advisory committee, and offering a degree with major(s) in that subject area. Interdepartmental programs have been officially approved and may offer courses.

Aerospace Engineering

Lennox N Wilson, Acting Head of Department

Professors: Anderson, Hsu, Iversen, McDaniel, Peterson, Pierson, Tannehill, Wilson

Associate Professors: Hermann, James, Seversike, Stuve

Assistant Professor: Hindman

Undergraduate Study

For undergraduate curriculum in aerospace engineering leading to the degree Bachelor of Science, see *College of Engineering, Curricula.*

The aerospace engineer is primarily concerned with the design, analysis, testing, and over-all operation of vehicles which operate in an atmosphere, a fluid medium, or outer space as well as on water and land surfaces. The curriculum is designed to provide the student with an education in the fundamental principles of aerodynamics, flight mechanics, propulsion, structural mechanics, controls, design, testing, space, and hydrospace technology. A wide variety of opportunities await the aerospace engineering graduate in research, development, design, production, sales, and management in the aerospace industry, and in many related industries in which fluid flow, control, and transportation problems play a major role.

A cooperative education program in aerospace engineering is available in conjunction with several industries and government concerns. The usual four-year curriculum is extended over a five-year span to permit alternate industrial experience periods and academic periods. This arrangement offers valuable practical experience and financial assistance during the college years. See *College of Engineering, Cooperative Programs.*

Graduate Study

The department offers work for the degrees Master of Engineering, Master of Science, and Doctor of Philosophy with major in aerospace engineering, and minor work to students taking major work in other departments. For all graduate degrees, it is possible to establish a co-major program with another graduate degree granting department. Within the aerospace department, work is available in the following areas: computational aerodynamics, optimization, atmospheric and tornado sciences, control systems, atmospheric and space flight mechanics, structural analysis, gasdynamics, turbulence, combustion, and swirling flow.

The major work for the degrees Master of Science and Doctor of Philosophy requires an acceptable thesis in addition to the course work. For the degree Master of Engineering, a comprehensive paper or suitable project as evidence of independent accomplishment is required. Appropriate credit is allotted for this requirement.

Minor work for aerospace engineering majors is usually selected from mathematics, physics, electrical enginaering, engineering mechanics, mechanical engineering, and meteorology.

The normal prerequisite to major graduate work in aerospace engineering is the completion of a curriculum substantially equivalent to that required of aerospace engineering students at this University. However, because of the diversity of interests within the graduate programs in aerospace engineering, a student whose prior undergraduate or graduate education has been in allied engineering and/or scientific fields may also qualify. In such cases, it may be necessary for the student to take additional work to provide the requisite background in a chosen area of interest. A prospective graduate student is urged to specify the degree program and the specific field(s) of interest on the application for admission.

Courses normally will be offered as stated in the course description. Where no specific time of offering is stated, the course may be offered during any semester provided there is sufficient demand.

The department also participates in the interdepartmental programs of Energy Systems Engineering, and Technology and Social Change. (See Index.)

Open to graduate students for minor credit only: 321, 341, 342, 351, 355, 411, 412, 419, 421, 422, 431, 432, 441, 442, 451, 455, 461, 462, 464, 485.

Courses Primarily for Undergraduate Students

101. Introduction to Aerospace Engineering. (1-2) Cr. 2. F.S. Historical development in aeronautics and astronautics. Introduction to aerodynamics, aerospace structures and performance, and flight mechanics. A special laboratory fee may be charged for use of university aircraft.

241, 242. Aerodynamics I, II. (3-0) Cr. 3 each. 1 Yr. *Prereq: 241: Math 166, Phys 221; 242: 241.* Introduction to applied aerodynamics of wings, bodies, and aerospace vehicles. Incompressible and compressible flow. Performance of aerospace vehicles.

271. Aerospace Laboratory I. (0-3) Cr. 1. S. *Prereq: Credit or classification in 242.* Practical application of

aerospace principles and concepts through laboratory studies and experiments

298, 398, 498. Cooperative Education. Cr R F S.SS Required of all cooperative education students *Prereq Permission of department head, 298: sophomore classification; 398: junior classification, 498. senior classification* Students must register for these courses prior to commencing each work period

300. Inspection Trip. Cr R S *Prereq: Junior or senior classification.* Inspection trip to industrial and/or government aerospace facilities. Trip normally taken during spring break. Fee

321. Flight Structures Analysis. (3-0) Cr 3. S *Prereq E M 324, M S E 371.* Determination of flight loads. Materials selection for flight applications. Analysis of flight structures in unsymmetric bending, bending of two-material beams, torsion, shear flow due to bending and torsion in thin-walled structures, elastic instability

340. Introduction to Aerodynamics and Space Flight. (3-0) Cr 3 F S. *Prereq: Math 265, Phys 221* Aerodynamics of flight vehicles Dynamics of space flight. For nonaerospace engineering students.

341. Aerodynamic Theory I. (3-0) Cr 3 F *Prereq. Math 266* Incompressible potential flow, Euler's equations, thin airfoil and finite wing theory

342. Aerodynamic Theory II. (3-0) Cr 3 S *Prereq 341, M E 330 or 331.* Energy equation, compressible flow, shock and expansion waves, linearized subsonic and supersonic flow, transonic flow, hypersonic flow

350. Science of Flight. (2-0) Cr 2 F *Prereq: Phys 111 or 221.* A concise explanation of the aerodynamics, performance, stability and control, and handling qualities of an aircraft Intended for nonengineering majors

351. Astrodynamics I. (3-0) Cr 3 F *Prereq Math 265, E M 345* Introduction to astrodynamics, two-body motion, coordinate systems, launch vehicle trajectories, and atmospheric entry trajectories Orbital transfer methods, lunar and interplanetary trajectories.

355. Flight Vehicle Stability and Control. (3-0) Cr 3 S *Prereq 242, Math 267, E M 345* Aircraft rigid body equations of motion Longitudinal and lateral-directional static and dynamic aircraft stability and control Flight handling characteristics.

371. Aerospace Laboratory II. (0-3) Cr 1 *Prereq 242, 271* Application of aerospace principles and concepts through laboratory experiments

372. Aerospace Laboratory III. (0-6) Cr 2 *Prereq. 371, credit or classification in 355.* Application of aerospace principles and concepts through laboratory experiments. Solution by analog and digital computer

411. Aerospace Vehicle Propulsion I. (3-0) Cr 3 F *Prereq. 342.* Fanno and Rayleigh flows Combustors and combustion Three-dimensional flows in nozzles, diffusers, and ducts. Principles of internal combustion engines, turbojet, turbofan, turboprop, ramjet, and rocket propulsion systems

412. Aerospace Vehicle Propulsion II. (3-0) Cr 3 S *Prereq: 411* Performance, dynamics, and control of turbo-engines. Blade element theory applied to propellers, axial flow compressors, turbines, and fans Engine core and jet noise Solid and liquid rocket engine construction and operation Nuclear and electrical propulsion

419. Principles and Techniques of Remote Sensing. (C E 419) (3-0) Cr 3. F. *Prereq: Phys 222.* Principles, techniques, and accuracies of remote sensing methods. Principles of photographic systems, radar, passive microwave, infrared, visible and ultraviolet imaging, with capabilities, limitations and utilization of each system.

421. Advanced Flight Structures. (3-0) Cr 3. F *Prereq. 321, Math. 266.* Analysis of indeterminate flight structures. Application of finite element analysis to flight structures. Introduction to dynamic analysis of wing and fuselage structures.

422. Aeroelastic and Thermal Analysis of Flight Structures. (3-0) Cr. 3. S. *Prereq: 421.* Analysis of static and dynamic deformation of elastic aerospace structures. Introduction to aeroelasticity, wing divergence, and flutter Analysis of hot structures.

431. Flight Control Systems I. (3-0) Cr 3. F *Prereq: 355.* Linear systems analysis using frequency response and root locus methods. Aircraft automatic controls systems and stability augmentation.

432. Flight Control Systems II. (3-0) Cr. 3. S. *Prereq. 431.* Aircraft inertial cross-coupling stabilization. Launch vehicle pitch control system design. Control system design for flexible vehicles. Active satellite attitude control State variable description of flight control systems. Pole placement controller design Introduction to sampled-data systems.

441. Aerodynamic Theory III. (3-0) Cr 3 S *Prereq 342* Viscous flow theory Boundary layer Aerodynamic heating

442. V/STOL Aerodynamics and Performance. (3-0) Cr 3 S *Prereq: 341, 355.* Introduction to the aerodynamics, performance, stability, control and critical maneuvering characteristics of aerospace vehicles such as V/STOL aircraft, helicopters, hovercraft, and other short-range transportation vehicles

451. Astrodynamics II. (3-0) Cr 3 S *Prereq 351* Orbit determination and prediction methods Many-body problem General and special perturbation methods as applied to satellite and spacecraft trajectories Introduction to universal variable methods

455. Flight Systems Testing. (2-3) Cr 3 S *Prereq 355* Principles of flight testing Techniques of data acquisition and data analysis. Planning a flight test program Conducting a flight test program Fee charged for use of university aircraft

461. Design and Analysis I. (1-6) Cr 3 F *Prereq Senior classification* Application of the principles and methods of analysis and synthesis in the solution of aerospace engineering design problems with emphasis on aircraft design

462. Design and Analysis II. (1-6) Cr 3 S *Prereq 461* Preliminary design of aerospace vehicles Detail design of aerospace vehicle components. Fundamental principles used in engineering development of aircraft, missile, and space systems

464. Spacecraft Systems Engineering (3-0) Cr 3 S *Prereq. 461, Phys 222, E E 441* Space environment, spacecraft, launch vehicle integration, placement in orbit, attitude control systems, attitude sensing systems, space communications, space power, thermal control, structures and mechanisms, scientific instruments

471, 472. Senior Projects. (0-3) Cr 1 each Yr *Prereq senior classification, approval of department head* Development of aerospace principles and concepts through individual projects Preparation and presentation of a technical paper is normally required of all students in these courses

485. Introduction to Hydrospace Engineering. (3-0) Cr 3 S *Prereq 341, 355, Phys 222* Introduction to elementary hydrospace vehicle performance, stability and control

490. Independent Study. Cr 1 to 6 Arr *Prereq Junior or senior classification, approval of the department head*

A Aero and/or Gasdynamics
B Propulsion
C Stress Analysis
D Flight Mechanics
E Flight and Space Systems
F Hydrospace
G Aeroelasticity
H Honors
I Design
J Hypersonic Testing
K Model Towing Basic Testing
L Satellite Measurement Techniques

491, 492. Aerospace Seminar. (1-0) Cr R F S

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

521. Airframe Analysis. (3-0) Cr 3 F *Prereq 421* Analysis of static and dynamic stresses and deformations in continuous aircraft structures Approximate and numerical analysis of static and dynamic stresses and deformations in airframe design by normal mode technique

525. Advanced Aeroelasticity I. (3-0) Cr 3 S *Prereq. 521, 544.* Static aeroelastic analyses of flight vehicles and lifting surfaces. Lifting surface and panel flutter Dynamic response and load studies of flight vehicles using normal modes.

531, 532. Automatic Controls for Flight Vehicles I, II. (3-0) Cr 3 each Alt. Yr *Prereq: 531: 431, 532: 531* Theory of automatic control of flight vehicles Spacecraft attitude control Control of flexible vehicles. Optimal controls. Adaptive controls.

533. Thermodynamics of Compressible Flow II. (M E 533) See Mechanical Engineering

534. Experimental Gas Dynamics. (M E 534) See Mechanical Engineering

541, 542. Advanced Aerodynamics I, II. (3-0) Cr 3 each Yr *Prereq 541: 341 or M E 424; 542: 541* Classical flow theory, compressible fluid theories, shock wave studies, and applications to aerodynamic shapes

543. Advanced Aerodynamics III. (3-0) Cr 3 F *Prereq 542.* Applications of classical flow theory, compressible fluid theories, and shock theory to aerodynamic shapes.

544. Applied Wing Theory. (3-0) Cr 3 F *Prereq. Credit or classification in 541.* Methods of estimating the aerodynamic characteristics of swept and unswept, steady and oscillating wings in subsonic and supersonic flight

546, 547. Computational Fluid Mechanics and Heat Transfer I, II. (M E 546, 547) (3-0) Cr 3 each Yr *Prereq 546. credit or classification in 541 or E M 571, 547 546* Introduction to finite difference methods used in modern engineering Solution of example problems in fluid mechanics and heat transfer 547 Application of computational methods to current problems in fluid mechanics and heat transfer

551. Space Flight Mechanics. (3-0) Cr 3 F *Prereq 351* General equations of motion for rigid body flight vehicles Coordinate systems and time keeping Two-body motion orbit transfers Patched conic and multi-conic interplanetary trajectories Restricted three-body problem

552. Entry Dynamics. (3-0) Cr 3 S *Prereq 551* Atmospheric entry and entry dynamics of missiles and spacecraft Trajectory control Descent and landing Thermal protection considerations Entry vehicle attitude control

555. Atmospheric Flight Mechanics. (3-0) Cr 3 S. *Prereq 355* Use of energy methods and optimization in the performance analysis of highly maneuverable aircraft and missiles Stability and control analysis of flight vehicles Introduction to parameter identification

571 Environmental Aerodynamics. (3-0) Cr 3 As arranged *Prereq 341* Survey of atmospheric turbulence, turbulent diffusion, and velocity profile within the atmospheric boundary layer with emphasis on modeling by means of the environmental wind tunnel

575. Tornado Fluid Mechanics. (3-0) Cr 3 As arranged *Prereq 341* Formation of atmospheric vortices, interaction of atmospheric vortices with the earth's surface, laboratory modeling of tornado vortices

590. Special Topics. Cr 1 to 5

A Aero and/or Gasdynamics
B Propulsion
C Stress Analysis
D Flight Mechanics
E Flight and Space Systems
F Magnetofluiddynamics
G. Hydrospace
H Viscous Aerodynamics
I Design
J Hypersonic Testing
K Model Towing Basin Testing
L Hypervelocity Testing
M Computational Aerodynamics
N Severe Storm Technology
O Optimization

Courses for Graduate Students, major or minor

620. Seminar. (1-0) Cr. 1

621. Aerospace Structures Analysis. (3-0) Cr 3 S *Prereq: 521.* The application of transfer matrix techniques to the analysis of various types of large aerospace structures under static, dynamic, and buckling loads

625. Advanced Aeroelasticity II. (3-0) Cr 3 As arranged *Prereq: 525.* Aerodynamic and structural instabilities of fixed and rotating wing flight vehicles under discrete and random dynamic loads

635, 636. Optimization in Aerospace Engineering I, II. (3-0) Cr 3 each As arranged. *Prereq: 635. 542; 551, 636: 635.* Applications of parameter optimization, dynamic programming and optimal control theory to problems in aerodynamics, aircraft structures, flight mechanics, design and performance Singular optimal control problems. Pursuit/evasion differential games. Branched optimal trajectories. Optimal control of distributed parameter systems.

641, 642. Hypersonic Flow Theory I, II. (3-0) Cr 3 each As arranged. *Prereq: 641: 542; 642: 641.* High Mach number flows, Newtonian theory, small disturbance theory, constant density solutions, thin shock layers, blunt body problems, hypersonic boundary layers and viscous interactions

645, 646. Magnetofluiddynamics I, II. (3-0) Cr. 3 each. As arranged. *Prereq: 645: 542; 646: 645.* Electromagnetic theory, equations of motion for viscous, heat and electrically conducting fluids of multiple species, wave motions, engineering problems in magnetohydrodynamics and magnetogasdynamics Radiation gasdynamics.

647, 648. Dynamics of Real Gases I, II. (3-0) Cr. 3 each. As arranged. *Prereq: 647: 542; 648: 647.* Introduction of quantum theory and statistical mechanics to thermally and calorically imperfect gases, theories of harmonic and anharmonic oscillators, vibrational relaxing and chemically reacting flows behind a strong shock and through an expansion nozzle. Gasdynamic lasers.

650. Fluid Mechanics Seminar. (E M 650, M E 650) (1-0 to 3-0) Cr. 3 each time taken. F. *Prereq: Permission of instructor.* Special topics of current research interest to students and staff of departments concerned.

651, 652. Mechanics of Space Vehicles Maneuvers I, II. (3-0) Cr 3 each. As arranged *Prereq: 651. 551; 652: 651.* Vehicle orbital transfers, intercept and rendezvous problems, spacecraft and satellite attitude control using active and passive methods and entry vehicle control

690. Advanced Topics. Cr. 1 to 5
A. Aero and/or Gasdynamics
B Propulsion
C Stress Analysis
D Flight Mechanics
E. Flight and Space Systems
F Magnetofluiddynamics
G Hydrospace
H Viscous Aerodynamics
I Design
J Creative Component
K Computational Aerodynamics

699. Research.

Agricultural Education

Harold R. Crawford, Head of Department

Professors: Crawford, Hoerner, Kahler, Lawrence, McClelland, Parsons, Williams

Emeritus Professor: Bundy

Associate Professor: Carter

Assistant Professor: Cosner, Miller, Trede

Undergraduate Study

For undergraduate curriculum in agricultural education and agricultural extension education leading to the degree Bachelor of Science, see *College of Agriculture, Curricula*.

The curriculum in agricultural education prepares persons for careers as vocational agriculture instructors, or as educational personnel in agricultural businesses, industries, and agencies. The curriculum in agricultural extension education prepares persons for careers as agricultural extension personnel

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with major in agricultural education and minor work to students taking major work in other departments. Candidates pursuing the Master of Science degree may do so by completing either a thesis or nonthesis program of study. Complete descriptions of these programs are available in the department.

The department cooperates with other departments in the College of Agriculture to offer work for a co-major Master of Science degree to prepare area school and community college agriculture teachers.

Prerequisite to major graduate work in agricultural education is preparation substantially equivalent to the completion of the undergraduate curriculum in agricultural education or agricultural extension education offered at Iowa State University and adequate proof that the student ranks above average in scholastic ability and promise of vocational competence.

Off-campus courses are offered for professional personnel in the field. Three-week courses and workshops are offered during the summer sessions.

Courses Primarily for Undergraduate Students

110. Orientation in Agricultural Education. (1-0) Cr. R F

111. Introduction to Agricultural Education. (1-0) 8 weeks. Cr 0.5 F.S. *Prereq: 110.* Review of the agricultural teaching profession in secondary and post-secondary schools.

211. Survey of Vocational Agricultural Programs. (1-0) Cr 1 F S. *Prereq. 111, admission to early experience program* Survey of programs of education in agriculture. Providing instruction on agricultural topics during the summer months. Included are four days of full-time observation and supervised experience under the direction of an instructor of agriculture. Advanced registration required.

214. Observation and Survey of Programs in Agricultural Extension Education. (1-0) Cr. 1. F.S. Visitation to central staff departments, county programs and special day activities, observation and discussion of extension programs in agriculture and home economics.

290. Special Problems in Agricultural Education. Cr 1-3. F S.SS.

311. Coordinating SOE Programs and FFA in Vocational Agriculture. (4-0) Cr 4 F S *Prereq 211* SOE and FFA program development. Planning, organizing, coordinating, and evaluating farm and off-farm occupational experiences and FFA activities in programs of agriculture.

312. Occupational Experience. (0-4 to 0-12) Cr. 1-3 F.S *Prereq. 211 or 214.* Supervised occupational experiences in agriculture with application of educational practices and principles.

314. Developing Comprehensive 4-H-Youth Programs. (3-0) Cr 3 S. *Prereq: 214.* Theory of 4-H program planning and development and the role of the 4-H-youth position. Needs assessment, working with committees, implementation and evaluation procedures Observation of local county, area, and state 4-H programs

410. Program Development in Vocational Agriculture. (2-0) Cr. 2. F.S. *Prereq: 311.* Planning and organizing vocational agriculture programs Developing courses of study, using advisory committees, planning and conducting summer and adult activities.

411. Methods of Teaching Vocational Agriculture. (4-4) 8 weeks. Cr 3. F.S. *Prereq. 311* Decision-making approach, selection of method, instructional planning and preparation, student evaluation, and class management. Departments may be visited to observe programs.

414. Supervised Experience in County and/or Area Extension Program. 8 weeks. Cr. 8. F.S.SS.

415. Seminar in Agricultural Education. (1-0) Cr. 1 F S. *Prereq: Junior classification.* Offered on a satisfactory-fail basis only.

416. Interim Supervised Teaching. Cr 1-2. F S. *Prereq: Full admission to teacher education.*

417. Supervised Teaching in Vocational Agriculture. 8 weeks. Cr 6. F S *Prereq: 411.* Supervised teaching in public schools.

490. Independent Study in Agricultural Education. Cr 1-3. F S.SS
A. Secondary School
B. Business and Industry
C Post-Secondary
D Extension

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

500. Short Course in Agricultural Education. Cr. 1. *Prereq: Permission of instructor.* Specific problems, issues, and content areas in agricultural education. On and off campus on arranged basis.

511. Instructional and Organizational Problems of Beginning Teachers of Agricultural Education. (0-2) Cr. 1 F S. *Prereq: 417.* Problems in instructional planning and methodology and in organizing the secondary, post-secondary, FFA, and agricultural experience programs. Offered on a satisfactory-fail basis only

512. Agricultural Education in the Career Development Process. (2-0) Cr. 2, Alt. F., offered 1981. *Prereq: 410, 411.* Humanistic components of the career development process. Relationship between self-concept development and current theories about work. Integrating agricultural education objectives and program activities into the career development process.

520. Instructional Methods for Teaching in Agricultural Education. (2-0) Cr. 2. Alt. S., offered 1982. *Prereq: 411.* Innovations and advanced principles in teaching methods and materials. Group techniques including decision making, developing interest and understanding, and student evaluation. Individualized instructional techniques and evaluation of instruction.

521. Leadership Development in Agricultural Education. (2-0) Cr. 2. Alt. S., offered 1983, *Prereq: 311.* Principles and practices of leadership development. Organization, implementation, and evaluation of individual and group leadership development in agriculture.

524. Program Development in Agricultural Extension Education. (2-0) Cr 2. Alt. F., offered 1981. *Prereq: Ad Ed 468.* Survey of agricultural needs and educational opportunities in local communities, counties and extension areas. Development of program objectives, implementation strategies, and evaluation procedures.

538. Young Farmer and Adult Education in Agriculture. (2-0) Cr. 2. Alt. SS., offered 1982. *Prereq: 410.* Problems and needs of young and adult farmers and workers in off-farm agriculture, survey techniques, uses of advisory councils, administrative relationship problems, program planning and evaluation.

539. Cooperative Occupational Experience Programs in Agriculture. (2-0) Cr. 2. Alt. SS., offered 1983. *Prereq: 311.* Organization, implementation, and administration of cooperative occupational experience programs in agriculture.

550. Occupational Guidance in Agriculture. (2-0) Cr. 2. Alt. F., offered 1982. *Prereq: 411.* The guidance function of the agriculture teacher, agricultural extension worker, and other agricultural leaders, occupational information, planning, placement, and followup.

560. Role of Agricultural Education and Agricultural Extension in Technology Transfer. (2-0) Cr. 2. Alt S., offered 1983. *Prereq: Soc 415.* Processes by which formal and informal agricultural education programs and agricultural extension influence introduction and acceptance of agricultural technology.

590. Special Topics in Agricultural Education. Cr. 1-3. *Prereq. 12 credits in agricultural education.*
A. Curriculum
B Methods
C Philosophy
D. Evaluation
E Administration
F Leadership
G. Guidance

593. Workshop in Agricultural Education. Cr. 1-3. SS. *Prereq: 12 credits in agricultural education.*
A. Curriculum
B. Methods
C Evaluation
D. Administration
E. Leadership
F. Guidance

599. Creative Component. For nonthesis M.S. degree programs.

Courses for Graduate Students, major or minor

604. Evaluation in Agricultural Education. (3-0) Cr. 3. Alt. F., offered 1981. Prereq: 410. Criteria and procedures for evaluation of programs in agricultural education. Selection and construction of evaluation devices. Use of results in program planning and implementation.

610. Curriculum Development in Agricultural Education. (3-0) Cr. 3. Alt. SS., offered 1982. *Prereq: 410.* Analysis of social, individual, and subject matter needs in agriculture and their impact on agricultural curricula. Application of new concepts and educational theory to curriculum planning in agricultural education.

615. Seminar in Agricultural Education. (1-0) Cr. 1. F.S.

617. Professional Development of Teacher Educators in Agricultural Education. (1-0) Cr. 1 F *Prereq: Permission of instructor.* Analysis of the roles and activities of teacher educators in agricultural education with emphasis on identifying and describing future personal roles in higher education.

620. Research Procedures in Agricultural Education. (3-0) Cr 3. S., 1982; SS., 1983. *Prereq. 9 credits in agricultural education and statistics.* Application of research methods to agricultural education research Identification of research priorities, selection and development of research design, and critique of research in agricultural education.

625. Administration and Supervision of Agricultural Education Programs. (3-0) Cr. 3. Alt. F , offered 1982 *Prereq: 520.* Management principles and practices of planning, organizing, directing, staffing and evaluating as applied to administration and supervision of programs in agricultural education

630. Philosophy and Policy Making in Agricultural Education. (3-0) Cr. 3. Alt. S., offered 1983. *Prereq 410, 411.* Basic philosophic premises in development of agricultural education programs at federal, state, and local levels. Impact of legislation on state and local policy making. Role of state and local advisory groups in policy making

699. Research.

Agricultural Engineering

Howard P Johnson, Acting Head of Department

Professors: Beer, Buchele, Giese, Hazen, Hoerner, Johnson, Laflen, Lovely, Marley, Melvin, Meyer, Pedersen, R J Smith, Van Fossen

Emeritus Professors: Beresford, Hull, Morford, Roth

Associate Professors: C Anderson, Baker, Bern, Bundy, Erbach, Kline, Mangold, Soderholm

Assistant Professors: W R Anderson, Bekkum, Greiner, Nicholson, Ozkan

Instructors: Boyd, Chaplin, Everett, Glanville, Hoagland, Hurburgh, McCarthy, Shorter, Slocombe, Tevis, Vosper, Wilcke, Williams

Undergraduate Study

For the undergraduate curriculum in agricultural engineering leading to the degree Bachelor of Science, see *College of Engineering, Curricula*

The curriculum in agricultural engineering provides training in the major fields of engineering applications to the industry of agriculture. Graduates from the curriculum find employment in agricultural production enterprises, in industries which supply goods and services to agriculture, and in the state and federal agencies responsible for agricultural engineering research, application, and education.

Employment for agricultural engineers is available in many agricultural industries. Professional services performed in the agricultural equipment industry include engineering design, development, manufacturing, product education, and sales. Services are rendered to industries supplying agricultural building materials and equipment, and in the design, construction, merchandising, and contracting of agricultural buildings. Students may also prepare for employment in design, development, construction, sales, and service in the areas of soil erosion control, drainage, and irrigation; rural electrification; crop processing and storage, materials handling in agriculture; and food engineering

The department has cooperative programs established for interested and qualified students The four-year curriculum is extended over a five-year period and interspersed with work periods at cooperating organizations This plan offers valuable practical experience and financial assistance during the years in college.

The department offers an undergraduate curriculum in agricultural mechanization, see *College of Agriculture, Curricula*. The agricultural mechanization courses are offered for students in the College of Agriculture. These courses include areas of agricultural mechanics, soil and water management, power and machinery, electric power, farm buildings, animal environment, crop storage and conditioning, and agricultural safety.

Graduate Study

The department offers work for the degrees Master of Science, Master of Engineering, and Doctor of Philosophy with major in agricultural engineering and minor work to students taking major work in other departments. Minor work is also offered in agricultural mechanization for students in the College of Agriculture, see *Agricultural Mechanization.* Within the major the student may specialize in soil and water resources, agricultural power and machinery, electric power and processing, and agricultural structures and environment.

Prerequisite to major graduate work is the completion of an undergraduate curriculum substantially equivalent to that required of agricultural engineering undergraduate students at this institution. However, because of the diversity of interests within the graduate programs in agricultural engineering, a student may qualify for graduate study even though the undergraduate training has been in a discipline other than engineering. Supporting work will be required depending on the student's background and area of interest with requirements defined by departmental guidelines.

For the degree Doctor of Philosophy the foreign language requirement, or a substitute, may be satisfied in one of three ways. (1) Demonstrate a communication competence (ETS score of 600 or 6 credit hours of 200 level) in one foreign language approved by the program-of-study committee. (2) Demonstrate a proficiency in FORTRAN computer language by course work (6 hours above Com S 172) or special examination. (3) Complete a minimum of 6 credits of additional course work not directly related to the major or minors. These courses are intended for the cultural enrichment of the student and are subject to the approval of the program of study committee.

The department also participates in the interdepartmental minor program in Energy Systems Engineering and in the interdepartmental programs in Technology and Social Change and Water Resources (see Index).

Open to graduate students for minor graduate credit only: 342, 371, 421, 422, 443, 444, 447, 463, 469, 471, 472.

Courses Primarily for Undergraduate Students

110. Seminar. (1-0) Cr. R. S. The field of agricultural engineering, its relation to the agricultural industry and to the engineering profession

201. Agricultural Engineering Concepts I. (3-3) Cr 4 F *Prereq: Credit or classification in Math 166.* Introduction to concepts of energy and mass flow. Analysis of the atmospheric environments. Aspects of agricultural hydrology Effects of environment on plants, animals, and crops. Engineering analysis of the physical and thermal environment for animals Environmental control for animals Principles of timber design.

202. Agricultural Engineering Concepts II. (3-3) Cr 4 S *Prereq: 201, Phys 221* Considerations in soil and water utilization Analysis of the elements of plant environment Concepts involved with crop production, including tillage, seeding, cultivation, and harvesting Electrical energy utilization in agriculture Principles of crop preservation Fee for field trips.

298, 398, 498. Cooperative Education. Required of all cooperative students *Prereq: Permission of department head* 298: Work periods for students with sophomore standing in a regularly established program 398 Work periods for juniors 498. Work periods for seniors Students must register for these courses prior to commencing each work period

302. Seminar. (1-0) Cr R S Preparation, presentations and discussion of papers on agricultural engineering subjects

342. Agricultural Tractor Power. (2-3) Cr 3. S *Prereq M E. 330.* Thermodynamic principles and construction of tractor engines Fuels, combustion, and lubrication Kinematics and dynamics of tractor power applications, drawbar, power take-off and traction mechanisms Fee for field trips

359. Materials Engineering with Applications in Agricultural Engineering. (M S E 359) (2-3) Cr 3. F *Prereq: E M 274, Chem 167* Introduction to atomic bonding structure of crystals and polycrystalline aggregates, phase equilibria, strength and deformation of solids Applications to engineering properties of metals Laboratory in welding, heat treatment, and testing of ferrous and non-ferrous alloys

371 Agricultural Structures. (2-2) Cr 3 F *Prereq 201, E M 324* Structural analysis and design of agricultural buildings Analysis of materials, design loads, and timber and concrete design

401. Seminar. (1-0) Cr R F *Prereq 302* Preparation, presentation, and discussion of papers on agricultural engineering subjects

421. Hydraulic Design of Soil and Water Control Facilities. (2-3) Cr 3 F *Prereq Credit or classification in E M 378.* Application of open channel flow principles to the design of irrigation, drainage and erosion control facilities Hydraulics of conduits and stilling basins Hydraulics of pumps Spatially varied flow Flow through porous media.

422. Drainage and Irrigation Engineering. (2-3) Cr 3 S *Prereq. 202, E M 378, Fr E 155L* Theory of subsurface drainage Design of surface and subsurface drainage systems. Design of field irrigation application systems Use of computers in solving soil and water conservation problems Fee for field trip

443. Agricultural Machinery Design I. (2-3) Cr 3 F *Prereq: 202, Fr E 155L, E M 345* Analysis of existing agricultural machines and identification of the new or improved machines. Establishment of functional performance, reliability and safety goals. Design of an agricultural machine or component to meet established goals

444. Agricultural Machinery Design II. (0-6) Cr 2 S *Prereq: 443.* Construction, testing, and evaluation of a machine or component designed in 443

447. Power and Control Hydraulics. (1-3) Cr 2 F *Prereq. Credit or classification in E M 378* Properties of hydraulic fluids Performance parameters of fixed and variable displacement pumps and motors. Characteristics of control valves. Analysis and design of hydraulic systems for power and control functions Fee for field trips.

463. Electrical Energy Application in Agriculture. (2-2) Cr 3. F *Prereq: E E 441.* Farm lighting and wiring system design. Electric motor characteristics and applications. Electrical safety. Electrical controls in agriculture. Standby power systems.

469. Processing, Handling, and Storage of Agricultural Materials. (3-3) Cr 4 S *Prereq: 202.* Principles of preservation by drying, chemical treatments, and oxygen-limiting techniques. Fan applications Material handling and processing. Physical properties of biological materials. System design. Fee for field trip

471. Principles of Livestock Waste Management. (3-0) Cr 3. F. *Prereq: Chem 167, E M 378.* Principles of chemistry, bacteriology, and engineering applied to the collection, treatment, and further use of animal wastes.

472. Environmental Engineering for Agricultural Structures. (2-0) Cr. 2. S. *Prereq: 201, M E 330.* Principles of animal environment. Analysis and design of environmental control systems. Insulation, ventilation, air distribution, heating and cooling systems, and controls.

490. Independent Study. Cr. 1 to 3.
F. Food Engineering
H. Honors
P. Power and Machinery
Q Structures and Environment
R. Electric Power and Processing
S. Soil and Water
U. Waste Management

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

501. Agricultural Resources Engineering. (3-0) Cr. 3. F *Prereq: One 400 level A E course.* Role of the engineer in agricultural resource development. Land and water resource development. Issues and restraints in agricultural technology. Research priorities, evaluation and support. Literature searches and project development.

502. Simulation of Agricultural Systems. (3-0) Cr. 3. S. *Prereq: Math 160, Com S 172, Stat 401.* Model development and computer simulation of processes and systems in agriculture. Model elements include soil, crop, animal and machine parameters. Interdisciplinary applications.

523. Erosion and Sediment Transport. (3-0) Cr. 3. Alt. F , offered 1981. *Prereq: Math 266 and one of the following: 421, Geol 377, Agron 577.* Erosion processes. Initiation of motion and overland flow Erosion models. Flow in alluvial channels and theory of transport. Surface soil and channel stability. Wind erosion.

563. Advanced Electrical Energy Applications in Agriculture. (2-0) Cr. 2. Alt. S., offered 1982. *Prereq: 463.* Electrical energy use in agriculture. Research in agriculture electrification. Instrumentation methods.

569. Advanced Crop Conditioning and Storage. (2-0) Cr. 2 Alt. S., offered 1983. *Prereq: 469, Fr E 155L.* Computer simulation of grain drying. Grain deterioration. Non-linear airflow through grain. Research in crop conditioning and storage.

572. Advanced Design of Agricultural Building Systems. (3-0) Cr. 3. Alt. S., offered 1982. *Prereq: 471, 472.* Animal environmental control equipment; air distribution; optimization of thermal constraints; research instrumentation; solar energy; bulk storage of granular materials; manure management using anaerobic digestion; energy budgets for digesters; flow properties of manure slurries.

590. Special Topics. Cr. 1 to 3.
B Mechanization
N Crop Conditioning and Storage
P Power and Machinery
Q Structures and Environment
R Electric Power and Processing
S. Soil and Water
T Construction and Maintenance
U. Waste Management

Courses for Graduate Students, major or minor

646. Soil Dynamics. (1-2) Cr. 2. Alt. S., offered 1983. *Prereq: E M 324, Agron 577 or C E 360.* Stress-strain relationships in soils subjected to dynamic loads. Pull-slip-sinkage relationships of traction devices. Interaction of tillage energy and compactive energy

648. Harvesting Machines. (1-2) Cr 2. Alt. S., offered 1982. *Prereq: 443, 501.* Principles of cutting, gathering, threshing, and separating. Analysis of harvesting devices. Effects of crop condition, maturity, and moisture content on performance of functional components.

661, 662. Seminar. (1-0) Cr. 1 each. Yr. Discussion of research problems, methods, procedures, and reports.

690. Advanced Topics. Cr. var.

699. Research
B. Mechanization
N. Crop Conditioning and Storage
P Power and Mechanization
Q. Structures and Environment
R. Electric Power and Processing
S. Soil and Water
U. Waste Management

Agricultural Mechanization

Administered by the Department of Agricultural Engineering

H. P. Johnson, Professor in Charge

Undergraduate Study

The Department of Agricultural Engineering provides a curriculum for those students interested in agricultural mechanization. Courses in farm structures and animal environment, soil and water conservation, farm power and machinery, electric power and processing, construction and maintenance, and agricultural safety give the student knowledge of the application of engineering technology to agriculture.

The curriculum prepares students for careers with agricultural service organizations; farm machinery industries, electric power suppliers; governmental service agencies; farm buildings manufacturers or contractors; feed, fertilizer, and chemical companies; or in farming. In these careers, agricultural mechanization graduates may apply agricultural, biological, physical, mechanical, business, and safety knowledge to serve agriculture in the arees of production, promotion, management, sales and service, and testing, as well as in dealer and consumer education.

For undergraduate curriculum in agricultural mechanization leading to the degree of bachelor of science, see *College of Agriculture, Curricula*

Graduate Study

The Department of Agricultural Engineering offers courses for minor graduate credit in agricultural mechanization for students taking major work in other departments.

Open to graduate students for minor credit only: 424, 430, 435, 440, 450, 462, 474, 475, 476, 485, 488, 489, 490, 493, 494.

Courses Primarily for Undergraduate Students

110. Orientation in Agricultural Mechanization. (1-0) Cr. R F. The opportunities in agricultural mechanization. Special topics.

*134. Machinery Systems and Power Management. (3-2) 8 weeks. Cr. 2. S. For students in Winter Program in Farm Operation only. Principles of machinery operation, selection, sizing and cost analysis. Tractor operation and performance factors.

*154. Agricultural Maintenance Welding. (2-4) 8 weeks. Cr. 2. S. For students in Winter Program in Farm Operation only. Application of welding principles, and selection and operation of metal working equipment. Lab fee.

191. Principles of Mechanization in Agriculture. (2-0) Cr. 2. F. *Prereq: Freshman or sophomore classification.* Introduction to the application of engineering principles to problems in farm power and machinery, soil and water conservation, structures and animal environment, and agricultural electrification.

*235. Field Machines and Power Units. (2-3) Cr. 3. F. For students in 2-year Farm Operation Program only. *Prereq: One course in chemistry.* Machinery capacities and costs of use. Selection and management of machines. Evaluation of machine performance. Operating principles and construction of internal combustion engines, tractor components and systems. Tractor performance measurements.

*250. Agricultural Construction Materials and Procedures. (2-4) Cr. 3. F.S.SS. Selection of building materials and their application to agricultural construction. Lab fee.

*260. Electrical Energy in Agriculture. (1-3) Cr. 2. S.SS. Primarily for students in the winter and 2-year farm operations programs. Basic electricity and electrical safety for agriculture. Wiring, electric controls, and motors.

*273. Livestock Buildings and Equipment. (2-0) Cr. 2. S. Primarily for students in 2-year Farm Operation Program. Environmental considerations in livestock housing. Modified environment for confinement livestock buildings. Planning buildings and equipment for livestock production systems.

285. Metal Construction and Maintenance. (2-4) Cr. 3. F.S.SS. Selection and application of ferrous and non-ferrous metals. Welding, cold-working and hot-working metal in agricultural construction and maintenance. Lab fee.

324. Soil and Water Conservation Maintenance. (2-0) Cr. 2. F.S. Introduction to engineering principles applied to the planning of erosion control, drainage systems and farm water resource development. Fee for field trip.

325. Water Management in Rural Residential and Outdoor Recreation Areas. (2-0) Cr. 2. F. Development of individual water supply systems. Planning and management of small waste-disposal systems. Irrigation, drainage and erosion control considerations.

326. Conservation Surveying and Design. (0-3) Cr. 1. F.S. *Prereq: Credit or classification in 324 or 325.* Agricultural surveys for field area measurement, layout of conservation structures and drainage systems. Handbook design of conservation structures.

*330. Farm Machinery and Power Management. (2-3) Cr. 3. F.S. *Prereq: 3 credits of math.* Use of cost analysis for management of agricultural machinery and power sources. Selection, sizing, and introduction to operational principles required in the use of agricultural machines.

335. Tractor Power. (3-3) Cr. 4, F. *Prereq: 3 credits of math.* Gasoline and diesel tractor engine construction and operational principles. Electrical systems, drive trains; hydraulic systems. Operator safety and comfort.

350. Home Maintenance and Repair. (1-3) Cr. 2. F,S,SS. A practical course for the potential homeowner and handyman. Emphasis placed on planning home improvements, basic skill development, using hand tools, wiring practices, plumbing and use of building materials. Lab fee.

358. Small Power Equipment. (1-3) Cr. 2. F.S.SS. Operation, adjustment, maintenance and repair of small internal-combustion engines and associated equipment. Lab fee.

*360. Agricultural Electrification. (2-3) Cr. 3. F. Basic electricity. Lighting design, electrical safety, wiring, electrical controls, and motors for agricultural application. Planning farmstead electrical systems.

362. Crop Conditioning and Handling Systems. (2-3) Cr. 3. F. Principles, methods, and management practices of grain drying and high-moisture crop preservation systems, with emphasis on corn. Grain handling methods. Grain quality evaluation. System planning, cost analysis. Fee for field trip.

385. Metals and Welding. (2-4) Cr. 3. F.S.SS. Basic gas and arc welding principles, procedures and applications in maintenance and construction. Selection of welding power sources and electrodes for all open-arc welding processes. Production welding problems, inspection and certification. Lab fee.

424. Drainage and Irrigation Management. (3-0) Cr. 3. S. *Prereq: 324.* Development of knowledge in drainage and irrigation of agricultural lands, interaction of agencies involved, and relationships to water use and control in agricultural production. Fee for field trip.

430. Farm Machinery Principles and Mechanisms. (2-3) Cr. 3. Alt. S., offered 1982. *Prereq: 330, 335, Phys 111.* Principles of operation of agricultural machines. Study of mechanisms, forces, and strengths of machinery. Safety considerations in agricultural machinery.

435. Agricultural Safety. (1-3) Cr. 2. F. *Prereq: 250, 330, 360.* Risk recognition hazard analysis and danger evaluation in the agricultural industry. Epidemiological study of accidents. Product reliability, safe design and operation.

440. Intermediate Technology. (1-3) Cr. 2. S. *Prereq: 9 credits of agricultural sciences.* The philosophy and use of intermediate technology in developing countries. Design parameters, plans, and specifications of equipment. Case studies of appropriate technology.

450. Construction of Agricultural Structures. (1-4) Cr. 2. F.S.SS. *Prereq: 250.* A combination of construction

techniques and selected experiences associated with various types of agricultural structures: conventional frame, pole, rigid frame, unitized, and concrete and masonry construction

462. Advanced Crop Conditioning and Handling Systems. (2-0) Cr 2. Off campus, offered as requested *Prereq: 362.* Grain drying and high-moisture preservation methods. Psychrometrics. Fans and airflow Material handling methods. Computer simulation of grain drying. System planning. Designed for Master of Agriculture Program.

***473. Environmental Systems for Animal Production.** (3-0) Cr. 3. F. Effects of environment on animal production. Principles of environmental control Planning confinement systems for livestock; functional, economic, and environmental considerations.

474. Livestock Housing Systems. (2-0) Cr. 2. Off campus, offered as requested. *Prereq: 6 credits of agricultural or biological science.* Properties of moist air, effects of environment on animal performance, principles of environmental control, feed handling systems, manure management alternatives, planning total systems. Designed for Master of Agriculture Program.

475. Waste Management for Livestock Production Systems. (2-0) Cr. 2. S *Prereq. 6 credits of biological sciences, 3 credits of math* Introduction to the quantitative aspects of manure management, pollution and disease hazards. Measurements of pollution Design of storege structures and lagoon systems

476. Farmstead Planning. (1-2) Cr 2 S. *Prereq: 273 or 473.* Layout and organization of farmsteads Planning farm homes, livestock production buildings, structures for crop storage and machinery housing Plans, construction materials, and structural considerations for agricultural buildings.

485. Advanced Metal Construction and Maintenance. (1-4) Cr 2 S *Prereq. 285, junior classification.* Problems related to materials selection and welded metal construction from shop drawings. Lab fee

488. Teaching Agricultural Mechanics. (2-4) 8 weeks Cr 2 F S *Prereq 250, 285.* Organization and management of the agricultural mechanics instructional program, facility and equipment Students plan and present demonstrations of teaching agricultural mechanics skills

489. Developments in Agricultural Mechanics. (2-2) Cr 1 F S.SS Off-campus 5 weeks *Prereq 488* Selection, principles of operation, application and maintenance of equipment and materials used in mechanized agriculture Development of instructional units for vocational-technical programs
A Electricity in Agriculture
B Electric Motors
C Agricultural Structures
D Metal Construction
E. Agricultural Machinery
F. Hydraulics in Agriculture
G Diesel Tractors

490. Independent Study. Cr 1 to 5.
H Honors
P Power and Machinery
Q. Structures and Environment
R Electric Power and Processing
S. Soil and Water
T Construction and Maintenance

493. Engineering Principles for Food Technology I. (F Tch 493) See *Food Technology*

494. Engineering Principles for Food Technology II.. (F Tch 494) See *Food Technology*

***Credit for both courses from each of the following pairs may not be applied toward graduation: 134 and 330, 154 and 250, 260 and 360, 273 and 473.**

****Credit in 235 may not be applied toward requirements for a baccalaureate degree.**

Agricultural Studies

Lee R Kolmer, Dean of Agriculture

Extension, Research and Information Service

Charles E. Donhowe, Dean of University Extension

Professor: Donhowe

Emeritus Professors: Graff, Soults, Taff

Associate Professors: Almquist, Goettsch, Heer, Hegland, Hougen, Iverson, Johnson, Linstrom, Munster, Robb, Swenson, L. E Thompson, Wallize

Assistant Professors: Bogue, Ebert, Goering, Herman, Kuiper, Lem, Mackey, McGinnis, Ransom, Wishart

Instructors: Benn, Morris, Oelkers, G O. Thompson

Academic Programs

Louis M. Thompson, Associate Dean

Professors: Kolmer, Scott, L. M Thompson

Associate Professor: Whigham

Assistant Professor: Bruene

Instructors: Polito, Swainston, Wilkens

Courses listed below are offered for undergraduate students in all curricula of the College of Agriculture See also individual curricula in the section *College of Agriculture*

Courses Primarily for Undergraduate Students

102. Freshman Seminar I. (2-0) 8 weeks Cr 1 S Selected topics in agricultural science Orientation to academic life and university regulations Guest speakers

103. Freshman Seminar II. (2-0) 8 weeks Cr 1 S 1983 *Prereq 102* Selected topics in agricultural science with emphasis on sources of information and the application of modern technology Guest speakers

104. Practical Work. Cr R Practical work in the student's field of study. See adviser for departmental requirements

110. Orientation in Farm Operation. (1-0) Cr. R F Description of the opportunities and scope of the farm operation curriculum Assistance in learning the regulations of the University and career planning Also required in the Winter Program in Farm Operation.

290. Special Problems. Cr 1 to 2 *Prereq: Sophomore classification.* Independent study for two-year farm operation students in a specific area for which no course is available and in an area not assigned to an existing department Approved by the professor in charge of the farm operation curriculum

450. Farm Operation and Management. (2-4) Cr 3 F S.SS. *Prereq Econ 330, junior classification in the College of Agriculture* Participation in the management and operation of an Iowa farm. The class is responsible for the plans, records, and decisions of buying and selling of livestock, crops and equipment Trips to farms and markets. May be taken for credit a second time at a different time of the year. Fee for field trips.

490. Independent Study. Cr 1 to 2 *Prereq: Junior classification in the College of Agriculture.* Independent study of a specific area for which no course is available and in an area not assigned to an existing department. The proposal by the student is subject to the approval of the associate dean or the head of the farm operation curriculum

499. Senior Seminar. (1-0) Cr 1 F S. Current topics of importance in agriculture. Assistance in career planning Lectures by College of Agriculture staff and visitors.

Agronomy

John Pesek, Head of Department

Professors: Amemiya, I C. Anderson, Atkins, Benson, Black, Bremner, Burris, I E. Carlson, R E Carlson, Clark, Fehr, Fenton, Frey, George, Green, Hallauer, Hanway, Hodges, Palmer, Pearce, Pesek, Peterson, Robinson, Russell, Sadanaga, Schafer, Scholtes, Scott, Shaw, Shibles, Skrdla, Staniforth, Stritzel, Tabatabai, H M. Taylor, H. E. Thompson, L. M. Thompson, Troeh, Voss, Webb, Wedin, Woolley, Yarger

Emeritus Professors: Browning, Duncan, Kirkham, Pierre, Riecken, Schaller

Associate Professors: Campbell, Dumenil, Miller, Takle, Whigham

Assistant Professors: P F Anderson, Barnhart, Bhella, Blackmer, Cianzio, Crosbie, Cruse, Eik, Englehorn, Hansen, Henning, Loynachan, Mullen, Nicholson, Smith, S. E. Taylor, M. L Thompson, Vaughan

Instructors: Barnett, James, Ziegler

Undergraduate Study

For undergraduate curriculum in agronomy, see *College of Agriculture, Curricula.*

Students electing agronomy as a major will prepare themselves for positions in farming, agricultural industry, business, and government agencies. Graduates accept positions in the seed, fertilizer, and chemical industries as agronomists, production managers, and sales and promotion personnel. State and federal agencies employ agronomists as extension specialists, county extension directors, soil scientists, soil conservationists, and food and drug inspectors Land appraisal, farm management, turfgrass management, and pest management and crop protection are additional areas of work open to agronomists. Students interested in pest management and crop protection should consider taking pest management as a second major (see *Pest Management, Curriculum*). Students who are reasonably certain of going on to graduate school should elect the agronomic science specialty

Graduate Study

The department offers work for the degrees of Master of Science and Doctor of Philosophy, with majors in crop production and physiology, plant breeding and cytogenetics, soil physics, soil chemistry, soil fertility, soil microbiology and biochemistry, soil morphology and genesis, soil management, and agricultural climatology Minor work is provided for students with majors in other departments. An M.S. nonthesis option is available for students desiring to pursue a special project not involving thesis research The M.S. nonthesis requirement is completion of 34 hours of graduate credit, which must include 4 hours of creative component (Agron 599), submission and approval of a report on the special project undertaken, and satisfactory completion of a final oral examination

The department also cooperates in the interdepartmental programs of Immunobiology, Molecular, Cellular and Developmental Biology; Technology and Social Change; and Water Resources. (See *Index.*)

Prerequisite to major work in this department is completion of an undergraduate degree program with emphasis on biological and

physical sciences. The foreign language requirement, if any, for the Ph D degree is established on an individual basis by the advisory committee appointed to guide the work of the student.

Open to graduate students for minor credit only 318, 354, 364, 406, 412, 415, 421, 453, 454, 457, 473, 483, 485.

Courses Primarily for Undergraduate Students

110. Orientation in Agronomy. (1-0) Cr R F Opportunities and requirements of the agronomy curriculum Opportunities and challenges of a career in Agronomy

114. Principles of Crop Production. (2-3 to 6 individualized study) Cr 3 F S Green, Mulien Introductory principles of plant-soil-climate relationships in crop production

142. Crop and Soil Fundamentals. (4-0) 8 weeks Cr 2 S Woolley, Stritzel For students in the Winter Program in Farm Operation only Basic concepts and principles

144. Soil and Crop Management. (4-0) 8 weeks Cr 2 S *Prereq 142* Stritzel, Woolley For students in the Winter Program in Farm Operation only Integrating soil and crop fundamentals into profitable crop production systems

***154. Fundamentals of Soil Science.** (2-2) Cr 3 F S Alt SS 1983 *Prereq Chem 163* Schafer or Scholtes Introduction to physical, chemical and biological properties of soils, their formation, classification and distribution Can be taken under either a lecture-lab or an audiotutorial format

***156. Soils for Urban Use** (2-3) Cr 3 F Loynachan *Restricted to students outside the College of Agriculture* Fundamental properties of soils and their application to urban use Design of a site plan for area development from soil survey information will be emphasized Fee for field trips

206. Introduction to Meteorology. (Mteor 206) (2-0) Cr 2 F S Carlson Introduction to basic meteorological processes The general circulation, solar and terrestrial radiation, fronts, cyclones and anticyclones, weather maps, and forecasting

212. Grain and Forage Crops. (3-2) Cr 4 F S *Prereq 114* George Crop-plant characteristics, adaptation, and quality with major emphasis on the production and management of corn, soybeans, small grains, and forage crops common to Midwest agriculture

220. Crop Quality, Utilization, and Evaluation. (1-2) Cr 2 S *Prereq 114* Mullen A survey of various uses of agronomic crops Factors affecting crop quality, commercial grades, and utilization are emphasized One 1-day field trip is required Fee for field trips

237 Seed Production. (PP SW 237) (1-3) Cr 2 F *Prereq 154, 114 or Hort 221* Mullen Study of major seed production areas, environmental and physiological factors affecting production and management of seed crops Fees for field trips

238. Seed Technology. (PP SW 238) See Plant Pathology, Seed and Weed Sciences

241. Introduction to World Food Problems. (U St 241) See *University Studies.*

244. Soil Fertility and Crop Management. (2-0) Cr 2 S *Prereq 112 or 114, 154* Stritzel For two-year farm operation students only Integrating soil fertility and crop management principles and practices into profitable land-use programs Characteristics and use of fertilizers and agricultural chemicals in crop production

311. Seminar. (2-0) Cr 1 F S *Prereq Second semester junior or first semester senior classification* Staff Career planning, resume preparation, interviewing and job opportunities in agronomy are discussed Presentations from various agronomy-related disciplines are involved

318. Principles of Crop Physiology. (3-0) Cr 3 F S *Prereq. Bot 310 or 320.* Pearce Basic principles concerning the growth, development, and production of crop communities in relation to their environment

340. Chemical Use in Crop Production and Soil Management. (P M 340) (3-0) Cr 3. F S. *Prereq Course in organic chemistry.* Pearce. Managerial, physiological, and ecological effects of chemicals applied to crops and soils. Includes pesticides, growth regulators, soil stabilizers, and nitrification inhibitors. Fertilizers will not be included Types of formulations, proper application, safety, environmental aspects, historical aspects and legal considerations will be covared

351. Turfgrass Establishment and Management. (Hort 351) See *Horticulture*

354. Soil Fertility (2-3) Cr 3 F S Alt SS , 1982 *Prereq 154, 2 chemistry courses* Troeh or Loynachan Chemical, biological, and physical properties of soils in relation to plant growth and development Nutrient behavior in the soil Fertility evaluation Principles guiding use of lime, manure, and fertilizers

***357. Forest Soils.** (For 357) (2-2) Cr 3 F Scholtes Formation, classification and distribution of soils. Properties and processes of forest soils in relation to forest growth

364. Soil Resource Conservation. (2-3) Cr 3 S *Prereq 154 or 357* Troeh Relation of soil properties and land morphology to erosion Principles and methods of conserving soil Preparation of a land-use plan Out-of-town field trips. Fee charged for field trips

371. Intercollegiate Soil Judging. (0-3 to 5) Cr 1 to 4 1 cr each time taken, plus 1 additional credit for participants in regional or national contests. F.S. *Prereq. Permission of instructor* Describing and classifying soil by examination of soil profiles in the laboratory and on field trips Determination of soil texture, structure, color, and other properties Fee charged for out-of-town field trips

400. Agricultural Travel Course. Cr 3 SS *Prereq Junior or senior classification, permission of instructor Limited enrollment*
A. American Tour, offered 1983
B International Tour, offered 1982
Students taking this course will also be required to register for Animal Science 400 for 3 credits Tour and study of production methods in major crop and livestock regions of the United States and other countries Influence of climate, soil, topography, markets, and other factors on livestock and crop production Tour expenses paid by the student

406. Climate of the Continents. (Mteor 406) (2-0) Cr 2 S *Prereq Agron Mteor 206* Shaw The major climate controls and how they affect the world climate Climate classification Combining controls and classification to explain the pattern of climates of the different continents and the world

411. Seminar. (1-0) Cr 1 F S *Prereq Senior classification* Pesek and staff A study of technical crops and soils journals together with semitechnical journals pertaining to agronomy as a profession Student interpretation, writings, presentations and discussion

412. Crop Management. (2-0) Cr 2 F S Woolley *Prereq 212, junior or senior classification* Synthesis of crop management systems and practices using the principles of agronomic science Field crops commonly grown in the midwestern U S serve as a basis for grain crop management situations

415. World Crops. (3-0) Cr 3 F Whigham *Prereq 114* Origin, characteristics, adaptation, production, and products of economically important crops of the world with emphasis on crops not commonly grown in the midwestern U S

421. Introduction to Plant Breeding. (3-0) Cr 3 F S *Prereq Gen 320* Green Basic principles used in genetic improvement of plants A review of genetics and reproduction as related to plant breeding Methods of breeding self-pollinated, cross-pollinated, and asexually reproducing plants.

438. Seed Biology. (PP SW 438) See *Plant Pathology, Seed and Weed Sciences*

453. Fertilizers. (2-0) Cr 2 F S *Prereq 354* Stritzel Manufacture, agronomic use, and environmental impact of fertilizers Agronomic utilization of macro- and micro-nutrients as related to physical and chemical properties of soils, crop needs, and economic profitability

454. Soil Management. (2-0) Cr 2 F S *Prereq 212 or 354* Stritzel Integrating principles of soil science and economics into soil management programs Primary emphasis on tillage, soil and tissue testing, lime and fertilizer use, soil-air-water relationships, and organic, sandy, and forest soil management.

457. Soil Chemistry and Physics. (2-0) Cr 2 S *Prereq 354* Troeh Chemical, physical, and mineralogical properties of soils. Influence of particle size and mineralogy on soil properties. A study of the colloidal system and the movement of materials in soils

473. Soil Genesis and Survey. (2-3) Cr 4 F S. *Prereq 154 or 357* Scholtes. Development, characteristics, and identification of soils, study of soil profiles and soil landscapes, soil classification systems, theory and practice of soil mapping, interpretation of soil survey information, two 2-day field trips. Fee for field trips.

483. World Soil Resources. (2-0) Cr 2 S *Prereq Chem 163 (154 recommended).* Schafer Properties, classification and geographic distribution of soils with emphasis on their suitability for food production

485. Soil Biology. (Micro 485). (2-3) Cr 3. F. *Prereq 154, Micro 300.* Loynachan Description of organisms in the soil and plant environment, and their role in organic matter decomposition (including natural materials and man-made chemicals and wastes), nitrogen fixation and transformations, and other processes which directly or indirectly affect people

490. Independent Study. Cr arr *Open to qualified students, after consultation with professor in special area of interest.* Selected studies in crops, soils, or climatology according to needs and interests of student
H Honors

***Credit for only one course from the following may be applied toward graduation 154, 156, or 357**

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

500. Orientation Seminar. (2-0) Cr 1 F *Prereq: Graduate classification in agronomy, and from foreign country* Pesek and staff An introduction to Iowa and U S agriculture for international scholars Field trips when possible. Departmental role in the functioning of research, teaching, and extension in fulfilling the charge given the land-grant university

505. Microclimatology. (Mteor 505) (3-0) Cr 3 S *Prereq Agron Mteor 206* Shaw The heat exchange near the ground Radiation, turbulence, conductance and evaporation as components of the heat balance Temperature, wind and humidity conditions in the microclimate Modification of the microclimate

514. Crop Plant Ecology. (3-0) Cr. 3 F *Prereq 318, Gen 320* Crosbie Principles and concepts of origin, evolution, adaptation, and distribution of world crops Genetic and physiological aspects of crop plant behavior in natural and agro-ecosystems

516. Crop Physiology and Management. (2-0 or 3-0) Cr 2 or 3 S *Prereq. Bot 320.* Shibles, Anderson Physiology of crop growth, development, and productivity Application of physiological and ecological principles to crop culture and management Students may elect physiology only (10 wks, 2 cr) or the full topic (15 wks, 3 cr)

521. Intermediate Plant Breeding. (3-0) Cr 3 S *Prereq 421, Stat 401* Fehr Analysis of alternative breeding methods for improvement of crop plants. Strategies for hybridization and self-pollination Sterility systems and their relationship to breeding methods and commercial hybrid seed production.

522. Field Methods in Plant Breeding. (0-6) Cr 2 SS *Prereq. 521.* Field experience in planning and conducting plant breeding research for cross-pollinated and self-pollinated crops Offered on a satisfactory-fail basis only Fee for field trips

529. Cytogenetics in Plant Breeding. (2-2) Cr 3 Alt F, offered 1981 *Prereq: 521, Gen 501, 625.* Peterson. Chromosome recombination, principles of chromosome pairing, gene distribution within the genome, aberrations, polyploids, genome relations, aneuploids, nullisomic analysis, interspecific hybrids, cell fusion, evolution of the nucleotype, repetitive DNA, the eukaryotic genome, and emergent techniques for the genetic improvement of crops

534. Forages: Management and Utilization. (2-0) Cr 2 F *Prereq. 212, An S 319.* Wedin Forage (machine harvested and grazed) principles and practices leading to economic utilization systems. Emphasis on soil-plant-animal relationships under grazing and role of ruminants as forage converters.

541. Agricultural Climatology. (2-0) Cr 2 Off campus, offered as requested *Prereq: 206.* Basic concepts in agriculture climatology with emphasis on the weather-agriculture relationship and the microclimate-agriculture interaction Designed for the Master of Agriculture Program.

542. Advanced Crop Management. (2-0) Cr 2 Off campus, offered as requested. *Prereq: 318 or 412* Staff. Basic concepts in plant-soil-climate relationships with emphasis on recent advances in crop culture and management. Designed for the master of agriculture program.

551. Growth and Development of Perennial Grasses. (Hort. 551). See *Horticulture.*

553. **Soil-Plant Relationships.** (2-0) Cr 2 F *Prereq. 354* Blackmer Composition and properties of soils in relation to the nutrition and growth of plants

554. **Soil Environment-Root Relationships.** (2-0) Cr 2 Alt S, offered 1982 *Prereq: 354, Math 165 or 175* Cruse Implications of tillage practices on the soil environment and root activity. Effect of soil physical properties on soil erosion

558. **Laboratory Methods in Soil Chemistry.** (2-3) Cr. 3 F *Prereq. Chem. 211.* Tabatabai. Experimental and descriptive inorganic and organic analysis. Operational theory and principles of applicable instruments, including spectrophotometry, atomic and molecular absorption and emission spectroscopy, mass spectrometry, X-ray diffraction and fluorescence, gas and ion chormatography, and specific-ion electrodes

561 **Irrigation Agriculture.** (2-0) Cr 2 F *Prereq 354* Troeh Properties of soils in relation to irrigation, use and quality of irrigation water; reclamation of saline and sodic soils, management of irrigated cropland, irrigation in humid regions

575. **Soil Morphology, Genesis and Classification.** (3-0) Cr 3 F *Prereq: 473, 553* Morphology and formation of soils, systems of classification and geographical distribution of soils

577 **Soil Physics.** (2-0) Cr 2 F *Prereq 354, Math 166 recommended.* Relation to physical properties of soils to plant growth, particle size distribution, soil structure, clay minerals, soil moisture, soil air, and soil temperature

578. **Laboratory Methods in Soil Physics.** (1-3) Cr 2 S *Prereq 577* Methods of measuring soil physical properties such as texture density, and water content, and transport of heat, water and gases.

585. **Soil Microbiology and Biochemistry.** (Micro 585) (2-3) Cr 3 S *Prereq 485, one course in biochemistry* Loynachan Concepts and methods in dynamics and ecology of soil microorganisms, organic matter formation, enzymatic systems, and carbon and mineral cycles

590. **Special Topics.** Cr arr *Prereq 15 credits in agronomy* Literature reviews and conferences on selected topics in crops, soils, or climatology according to needs and interest of student.

599. **Creative Component.** Cr arr *Prereq. Nonthesis M S option only* A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee

A Agricultural Climatology
B Crop Production and Physiology
C Plant Breeding and Cytogenetics
D Soil Chemistry
E Soil Fertility
F Soil Management
G Soil Microbiology and Biochemistry
H Soil Morphology & Genesis
I Soil Physics

Courses for Graduate Students, major or minor

600. **Seminar.** (1-0) Cr 1 Reports and discussion of recent literature research

A. Crops. F.S Carlson or Hallauer
B Soils. F.S. Staff
C Soil-Plant-Climate. F S. Staff

609. **Agricultural Climatology Conference.** (0-1) Cr 1 F S SS *Prereq. Permission of instructor* Carlson, Shaw Literature reviews and conferences with instructor on special problems relating to agricultural climatology, beyond the scope of current courses offered

616. **Advanced Topics in Crop Physiology and Biochemistry.** (4-0) Cr 4 S. *Prereq. 516, Bot 511, 512, 513, permission of instructor* Anderson, Shibles An in-depth treatment of physiological and biochemical processes and their relationships to crop growth and development. Emphasis is placed on individual study followed by in-class discussion.

619. **Professional Development in Crop Production and Physiology.** (1-0) Cr 1 Alt. F, offered 1981 *Prereq Permission of instructor* Shibles, Wedin The organization of agricultural research in the United States, instruction and practice in research proposal preparation, writings of professional papers, and presentation of papers at national meetings, organization and teaching of university-level courses, advising graduate students; the extension education career; ethics in science; vita preparation; interview interaction; other professional-related topics

620. **Colloquium in Crop Production and Physiology.** (1-0) Cr 1 F S *Prereq Permission of instructor* Anderson Presentation of papers and informal discussion of related literature topics in crop physiology and crop production

621. **Advanced Plant Breeding.** (3-0) Cr 3 S *Prereq 521, Stat 436, Gen 501* Russell Heritability, estimation of genetic effects and genetic advance; inbreeding depression and heterosis; development of parental materials, prediction of hybrid and synthetic performance, general and specific combining ability; procedures and problems in progeny evaluation

625. **Population Development and Utilization in Plant Breeding.** (3-0) Cr 3 Alt F, offered 1982 *Prereq: 521, Stat 436, Gen 501* Frey Natural systems of reproduction and their consequences in crop improvement Methods for generating genetic variation, including the use of exotic germplasm and interspecific hybridization Populations in plant breeding strategies Characteristics of cultivar populations relative to agricultural production

629. **Colloquium in Plant Breeding and Cytogenetics.** (1-0) Cr 1 Alt S, offered 1982 *Prereq Permission of instructor Peterson Presentation* of papers and informal discussion of related literature in plant breeding and cytogenetics

634. **Research Methods for Pasture and Forages.** (2-0) Cr 2 Alt S, offered 1982 *Prereq: 534, Stat 401* Wedin Study of appropriate pasture and forage intake quality assessment in studies dependent on animal effects Adaptation of methods to grassland development situations Considerations of forage economics and system analyses Student reports on current research literatura

655. **Advanced Soil Fertility.** (2-0) Cr 2 Alt S., offered 1983 *Prereq 553* Evaluation of soil fertility and fertilizers, theory and applications

657 **Advanced Soil Chemistry.** (2-0) Cr 2 Alt S, offered 1983 *Prereq 553, Chem 321 Scott* Structural and surface chemistry of soil clay minerals

675. **Advanced Soil Genesis and Classification.** (2-0) Cr 2 Alt S, offered 1982 *Prereq 575* Fenton Processes, reactions, and theories in soil formation, principles of soil classification

677 **Advanced Soil Physics.** (2-0) Cr 2 Alt S, offered 1983 *Prereq. 577, Math 266, 267 recommended* The flow and distribution of water, gas, and heat in soils Physical principles and applications

685. **Advanced Soil Biochemistry.** (Micro 685) (2-0) Cr 2 Alt S, offered 1982 *Prereq. 585* Bremner Nature of soil organic matter and biochemical transformations brought about by soil microorganisms

699. **Research.**

A Agricultural Climatology
B Crop Production and Physiology
C Plant Breeding and Cytogenetics
D Soil Chemistry
E Soil Fertility
F Soil Management
G Soil Microbiology and Biochemistry (Micro 699)
H Soil Morphology and Genesis
I Soil Physics

Air Force Aerospace Studies

Graham P Crow, Head of Department

Professor: Crow

Associate Professor: Dotson

Assistant Professors: Deterich, Hart

Undergraduate Study

The objective of Air Force Aerospace Studies is to provide qualified students the opportunity to serve as officers in the active Air Force, the Air National Guard, or the Air Force Reserve

The curriculum is divided into two basic phases, the general military course (GMC) and the professional officer course (POC) The GMC is introductory and consists of four consecutive 1-hour courses normally taken during the freshman and sophomore years The GMC is not prerequisite to entry into the POC, although it is recommended by the department.

Prior to entry into the POC, all students complete field training at an Air Force base. Students who have completed the GMC participate in a 4-week program, which provides a concentrated experience in the Air Force environment. The training program includes junior officer training, aircraft and aircrew orientation, career orientation, survival training, base functions, and physical training. A 6-week training program is provided for those students entering the POC who did not take the GMC. This program includes all that is offered in the 4-week program, plus the academic and leadership laboratory experiences normally contained in the on-campus GMC courses.

Selection for the professional officer course is on a competitive basis, and cadets enrolling in this course must meet certain academic, mental, physical, and moral standards. Qualified cadets may elect classification as flight candidates and receive flight instruction during their final year in the POC. Upon enrollment in the POC, all cadets are required to complete a contractual agreement with the Air Force, which obligates them to 4 years of active duty as an officer in the United States Air Force if in a nonflying category, and up to 7 years if a pilot or navigator Uniforms and texts are supplied to the cadets and those in the POC receive a subsistence allowance of $100 per month

Entry into the program is not dependent on departmental major or year in the university A 2-year applicant must, however, spend 2 years as either an undergraduate or graduate student in an approved program in order to satisfy POC enrollment requirements. A student who fails to observe the contract terms may be called to active duty in an enlisted grade.

The best qualified cadets participate in a college scholarship program (CSP) that provides payment of full tuition, fees, and textbooks. In addition, the CSP cadet receives the $100 monthly subsistence allowance paid all cadets who have entered into the contractual agreement Upon acceptance of a scholarship, the CSP student executes a contract with the Air Force. Scholarships can be awarded for periods of 2, 3, or 4 years. To determine the eligibility and initiate application procedures for the scholarship program, interested students should contact the department.

All GMC scholarship cadets must successfully complete or test out of a course in English composition. POC cadets must successfully complete a course in mathematical reasoning prior to commissioning. Additionally, cadets are encouraged to take a speech course

The AFROTC program is open to both male and female students. Applications from qualified female candidates are encouraged. Additional information concerning Air Force Officer Education may be obtained from the Professor of Aerospace Studies, Iowa State University. See also *Office Education.*

Courses Primarily for Undergraduate Students

141, 142. **The United States Air Force Today.** (1-0) Cr. 1 each. Yr. Development of the Air Force, its functions and organization; emphasis on functions of U.S. strategic offensive, defensive, and special purpose forces, relationships and interaction with Army and Navy forces. Review of writing skills.

141A, 142A, 241A, 242A. Leadership Laboratory. (0-1) Cr R each Yr Initial military training related to wearing the uniform, engaging in military customs and courtesies, participating in military ceremonies, giving military commands and instructions, correcting and evaluating such skills, and learning the responsibility of an Air Force officer Formal and informal presentations describing work of an officer Fee

241, 242. The Development of Air Power. (1-0) Cr 1 each Yr Development of air power from dirigibles and balloons through peaceful employment of U S air power in relief missions and civic action programs in the late 1960s, the air war in Southeast Asia, and the current posture of the Air Force Review of verbal communicative skills

341, 342. Air Force Management and Leadership. (3-0) Cr 3 each Yr Communication skills, management, and leadership listening, speaking, and writing skills required by an Air Force officer, management tools, practices, and controls, management principles and functions, leadership theory and practices

341A, 342A, 441A, 442A. Leadership Laboratory (0-1) Cr R each Yr Advanced leadership training pertaining to planning, organizing, supervising, conducting, inspecting, and evaluating military activities, preparing and presenting briefings and other communications, providing counsel, guidance, information, and other service which increase the understanding, motivation, and performance of other cadets Fee

441, 442. National Security Forces in Contemporary American Society. (3-0) Cr 3 each Yr *Prereq 342* The military profession, civil-military interaction, framework of defense policy, formulation of defense strategy, strategy and management of conflict Formulation and implementation of U S defense policy The officer classification and assignment system

American Indian Studies

Program Committee: G Bataille, J Dow, D Gradwohl, J Hraba, J Pudwill, H Schuster J Weinkein, J Whitaker

The American Indian studies program is a cross-disciplinary program in the College of Sciences and Humanities, which offers an opportunity to learn more about the cultural heritage of American Indians, their historical relationship with non-Indians, and their participation in contemporary American society This program serves both American Indian and non-Indian students and emphasizes perspectives from anthropology, history, literature, and sociology

The courses in the American Indian studies program provide added background for students whose career interests may include multicultural education, human services programming, legal services, or public administration

Within the College of Sciences and Humanities, courses in American Indian studies can be used in planning an area of concentration in a distributed studies major, in a minor, as components in an individual major, or as electives Students majoring in another college who wish to use these courses should consult their advisers

A minor in the College of Sciences and Humanities must include at least 15 credits of courses in the field A minor in American Indian studies must also include 210, 322 or 332, and at least two additional courses from a selected list of primary courses The American Indian studies program committee will, upon application by the student and review of the program, certify that the student has completed a minor in American Indian studies

American Indian studies courses may be used in an approved Sciences and Humanities individual major program An individual major consists of course work from various departments designed to reflect the student's particular interests and goals For details see *Sciences and Humanities Cross-Disciplinary Studies*

Courses Primarily for Undergraduate Students

210. Introduction to American Indian Studies. (3-0) Cr 3 F Introduction to the multi-disciplinary aspects of American Indian studies Guest lectures, media presentations, and discussion of assigned readings A major term paper or project expected, based on area of particular interest, i e , literature, art, history, anthropology, sociology, education, contemporary Indian politics

310 Selected Topics in American Indian Studies. (3-0) Cr 3 each time taken, maximum of 6 Alt S , offered 1982 Selected topics on specific cross-disciplinary subjects in American Indian studies

490 Independent Study. Cr Var *Prereq 6 credits in American Indian studies, permission of instructor* Designed to meet the needs of students who wish to study in areas other than those in which courses are offered

Primary Courses (Cross-llated)

322. The American Indian. (Anthr 322) See *Anthropology*

323. Contemporary Latin American Cultures (Anthr 323) See *Anthropology*

332 Contemporary Native Americans. (Anthr 332) See *Anthropology*

346. American Indian Literature (Engl 346) *See English*

420 Archaeology of North America. (Anthr 420) See *Anthropology*

520 Cultural Continuity and Change in the Prairie-Plains. (Anthr 520) See *Anthropology*

522 Seminar on American Indians (Anthr 522) See *Anthropology*

Primary Courses (Departmental)

Hist 370. History of Iowa. See *History*

Hist 465 The Westward Movement and Frontier Development. See *History*

Soc 300 Ethnic and Race Relations See *Sociology*

Soc 529 Minority Groups See *Sociology*

Anthr 428. Archaeological Laboratory Methods and Techniques. See *Anthropology*

Anthr 429 Archaeological Field School See *Anthropology*

Animal Ecology

Robert C Summerfelt, Chair of Department

Professors: R W Bachmann, Carlander, Dahlgren, Klaas, Menzel, Moorman, Summerfelt

Associate Professors: Atchison, M D Bachmann, Best, Dinsmore, Nickum

Assistant Professors: Clark, Franklin, Hubert

Undergraduate Study

The department offers work for the degree Bachelor of Science with majors in animal ecology and in fishenes and wildlife biology (see *College of Agriculture, Curricula*)

The animal ecology curriculum provides its majors with an understanding of basic ecological principles and processes It is oriented toward students desiring a general and flexible program in environmental biology, and for those planning graduate work in ecology The student, upon consultation with the academic adviser, may select courses in such areas as water pollution biology, population ecology, aquatic ecology, terrestrial ecology, nature interpretation, and environmental problems Graduates may find employment as ecologists for industry, environmental consulting firms, government agencies or as environmental protection administrators, and with supplemental education as teachers.

The fisheries and wildlife biology curriculum includes broad study of vertebrate biology and ecology as a basis for research and management of wildlife resources Special interests may be pursued through elective courses and summer employment Most employment opportunities in fisheries and wildlife biology are with government agencies Graduates are prepared for such positions as fisheries or wildlife biologist, conservation officer park naturalist, hatchery or game farm technician, or ecological survey technician

Both curricula require either three months of relevant work experience or study at a summer biological station prior to graduation The latter may be accomplished at the University's affiliate field stations, Iowa Lakeside Laboratory at West Lake Okoboji, Iowa, and Gulf Coast Research Laboratory at Ocean Springs, Mississippi Information on these laboratories is available from the department chairman

The department cooperates with the pest management program, and majors in both curricula may take a secondary major in this area

Preveterinary preparation may be accomplished while satisfying degree requirements in animal ecology

Additional education and training can lead to other opportunities in the fields of research and management biology, natural resources planning and administration, teaching, and environmental consulting, among others Graduate training is necessary for an increasing number of specialized positions within the fields of animal ecology and fisheries and wildlife biology Majors preparing for graduate study should consult with their academic advisers concerning appropriate coursework

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with majors in animal ecology, fisheries biology, and wildlife biology Within these majors, the student may also specialize in animal behavior, ecology limnology, or taxonomy

The Ph D degree requires proficiency in one foreign language This may be demonstrated by one year of college credit with a minimal average of 2 0 (on a 4 0 = A scale), by an Educational Testing Service Foreign Language Examination score of at least 500, or by committee approval of equivalent language experience The student's committee may require additional language competence

Personnel of the U S Fish and Wildlife Service, through the Iowa Cooperative Fishery and Wildlife Research Units, and the Iowa State Conservation Commission contribute to the graduate program of the department The department participates in the interdepartmental graduate program in Water Resources (see Index).

No more than two dual-listed animal ecology courses may be applied for major graduate credit

Open to graduate students for minor credit only 350, 410, 440, 441, 451

Courses Primarily for Undergraduate Students

110 **Orientation in Animal Ecology.** (2-0) Cr 1 F Orientation to the majors of and career opportunities in animal ecology and fisheries and wildlife biology

130. **Wildlife and Agriculture.** (2-0) Cr 2 F Survey of the ecology and management of fish and wildlife resources in areas of intensive agriculture, with emphasis on Iowa Wildlife conservation and management practices for private agriculture lands Designed for non-majors

231 **Wildlife Resource Conservation.** (3-0) Cr 2 S *Prereq Biol 109 or 110* Biological basis and principles of fisheries and wildlife conservation and resource management

300 **Seminar** (2-0) Cr 1 each time taken, may be taken more than once for graduation credit F S *Prereq Permission of instructor* Current topics in animal ecology, fisheries and wildlife biology, and environmental issues

312. **Ecology.** (Biol 312) See *Biology*

320 **Vertebrate Biology.** (2-0) Cr 2 F *Prereq Biol 110* Introduction to evolution and biology of vertebrates fish, amphibians, reptiles, birds, mammals

320L. **Vertebrate Biology Laboratory.** (0-3) Cr 1 F *Prereq Credit or classification in 320* Introduction to classification and identification of vertebrates fish, amphibians, reptiles, birds, mammals

321 **Ichthyology.** (2-4) Cr 4 S *Prereq 320L* Biology, classification, and identification of major freshwater and marine fish groups Field trips

322 **Herpetology** (2-3) Cr 3 Alt S, offered 1982 *Prereq 320L* Biology, life histories, classification, and identification of amphibians and reptiles Field trips

323 **Mammalogy.** (2-6) Cr 4 F *Prereq 320L* Ecology, natural history, identification, and classification of mammals with emphasis on how mammals adapt to and interact with their environment Field trips

324 **Ornithology.** (1-3) Cr 2 S *Prereq 320L* Ecology, behavior, and physiology of birds

325. **Bird Study.** (0-3) Cr 1 S Classification and identification of birds emphasizing midwestern species Field trips

350 **Wildlife Techniques and Habitat Analysis** (1-3) Cr 2 S *Prereq 231, 320L* Techniques and methods used in research and management of wildlife with emphasis on inventory and manipulation of wildlife populations and habitat Field trips

410 **Limnology** (2-0) Cr 2 F *Prereq 10 credits in biological sciences or graduate classification* Structure and function of aquatic ecosystems with application to fishery and pollution problems

440 **Fishery Management.** (2-0) Cr 2 F *Prereq 231, 320L* Biological basis of fishery management

441 **Fishery and Limnological Techniques.** (0-6) Cr 2 F *Prereq. Credit or classification in 410 or 440 or 510* Field and laboratory methods used in fishery and limnological studies Field trips

451. **Wildlife Management.** (2-3) Cr 3 F *Prereq 312, 350* Basic principles of managing wildlife populations Fee for field trips

490 **Independent Study** Cr arr F S SS *Prereq 10 credits in biological sciences and permission of instructor* Student-initiated field, laboratory, or library project

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

500 **Seminar.** (2-0) Cr 1 each time taken, may be taken more than once for graduation credit F S *Prereq Permission of instructor or graduate classification* Current topics in ecological research, fish and wildlife management, and environmental problems related to fish or wildlife resources Fee charged for sections requiring field trips.

510. **(410 DL). Limnology.** (2-0) Cr 2 F *Prereq 10 credits in biological sciences.* Graduate study in conjunction with 410 Additional work required for graduate credit. Not available for credit for students having taken 410

511. **Population Ecology.** (3-0) Cr 3 S *Prereq 312, Stat 401, a course in calculus* Theories and concepts of animal population dynamics and regulation with emphasis on the analysis of biological populations

512. **Vertebrate Behavioral Ecology.** (Zool 512) (3-0) Cr 3 Alt F, offered 1982 *Prereq 312, Zool 304 recommended* Selected topics in behavior considered relative to environmental influences and ecological concepts Includes predation, foraging, spacing, reproduction, and habitat selection

513. **Pollution Ecology** (3-0) Cr 3 Alt S, offered 1983 *Prereq 312* Ecological relationships between aquatic and terrestrial organisms and environmental pollutants Aspects of source, occurrence, persistence, toxicity, ecosystem dynamics, and rate of degradation of pollutants

514 **Evolutionary Ecology.** (4-0) Cr 3 S *Prereq 312, Biol 303, Gen 320 recommended* Relationships between animals and their environment, with major emphasis on adaptive strategies and evolutionary mechanisms

520 **Fish Ecology.** (3-0) Cr 3 Alt F, offered 1981 *Prereq 312, 321* Ecological interrelationships of fish communities in North American lakes and streams Emphasis on habitat and reproductive ecology, and community structure

521 **(321 DL) Ichthyology** (2-4) Cr 4 S *Prereq 320L* Graduate study in conjunction with 321 Additional work required for graduate credit Not available for credit for students having taken 321

522 **(322 DL) Herpetology** (2-3) Cr 3 Alt S, offered 1982 *Prereq 320L* Graduate study in conjunction with 322 Additional work required for graduate credit Not available for credit for students having taken 322

523 **(323 DL) Mammalogy** (2-6) Cr 4 F *Prereq 320L* Graduate study in conjunction with 323 Additional work required for graduate credit Not available for credit for students having taken 323

524 **(324 DL) Ornithology** (1-3) Cr 2 S *Prereq 320L* Graduate study in conjunction with 324 Additional work required for graduate credit Not available for credit for students having taken 324

531. **Wildlife Planning, Policy, and Administration** (3-0) Cr 2 Alt F, offered 1981 *Prereq A course in natural resource management* History and philosophy of wildlife administration, and modern methods for planning and implementing management policy Intended for students interested in employment in public or private agencies dealing with natural resources

541. **Fish Culture.** (2-3) Cr 3 Alt S, offered 1983 *Prereq 231, 320L* Principles and techniques of fish propagation, hatchery operation, nutrition, and disease problems Fee charged for field trips

543 **Advanced Fishery Management.** (2-3) Cr 3 F *Prereq 321, 410, 440, 441* Survey and evaluation of principles and techniques used in research and management of fishery resources Fee charged for field trips

551 **Wildlife Sociobiology and Management.** (2-2) Cr 3 Alt S, offered 1982 *Prereq 312, a course in wildlife management recommended* Examination and synthesis of social organizational and behavioral concepts important for wildlife management. Game and non-hunted wildlife species of the world treated.

590 **Special Topics.** Cr arr F S SS *Prereq Graduate classification, permission of instructor*

Courses for Graduate Students, major or minor

600 **Seminar** (2-0) Cr 1 each time taken F S Current topics in ecological research, fish and wildlife management, and environmental problems related to fish or wildlife resources Fee charged for sections requiring field trips

610. **Advanced Limnology.** (2-3) Cr 3 S *Prereq. 410 or 510, 441, Stat 401* Physical, chemical, and biological processes of lakes and streams and their relationships to biological productivity, ecological succession, and water quality Limnological research techniques Field trips

640. **Fishery Resources and Research Techniques.** (3-3) Cr 4 Alt. F, offered 1982 *Prereq. 440; Stat 401.* Major fishery resources and how they have been studied and managed Critical analysis

650. **Advanced Wildlife Management.** (3-3) Cr 4 Alt. F, offered 1982 *Prereq: 451* Advanced treatment of ecology and management of upland birds and mammals, ungulates, large carnivores, shorebirds, waterfowl, and selected furbearers Fee charged for field trips.

699. **Research**

*Courses Offered at the Iowa Lakeside Laboratory

302L. **Field Biology.** (4-12) Cr 3. SS. Animals in the field, with particular emphasis on their recognition and on collecting, preserving, and laboratory culture methods Field trips. Must be taken concurrently with Bot 301L

508L, 509L. **Aquatic Ecology.** (8-24) Cr 5 each SS Survey of local aquatic organisms and aquatic habitats, analysis of physiographic, physical, and chemical factors Emphasis on field work, methodology, and basic ecological principles Field trips.

**Courses Offered at the Gulf Coast Research Laboratory, Ocean Springs, Mississippi.

412G. **(ZO 452) Marine Ecology.** Cr. 4 *Prereq. Courses in general botany, invertebrate zoology and analytical chemistry.* A consideration of the relationship of marine organisms to their environment, including the effects of temperature, salinity, light, nutrient concentration, currents, and food on their abundance and distribution

442G. **(ZO 442) Marine Fisheries Management.** Cr 4 A general course in fisheries management designed to acquaint students with the philosophy, objectives, problems, and principles involved in management decisions Lectures will include specialists in biology, fisheries statistics, sanitation, and marine law.

443G. **(ZO 464) Marine Aquaculture.** Cr 6 *Prereq: general zoology or invertebrate zoology* A lecture, laboratory, and field course designed to introduce aquatic and marine biology students to the history, principles, problems, and procedures relating to the culture of commercially important crustaceans, fish, and mollusks along the Gulf Coast

*Written permission of the instructor is prerequisite to all courses offered at the Iowa Lakeside Laboratory. For current information concerning courses, registration, and housing, see the annual Iowa Lakeside Laboratory Bulletin. This bulletin is usually available from participating departments after February 15.

**Written permission of the coordinator of the Gulf Coast Research Laboratory, 201 Bessey Hall, Iowa State University, Ames, Iowa, 50011, is prerequisite to all courses offered at the Laboratory. Numbers beginning with ZO are GCRL numbers. Courses offered may vary from year to year.

Animal Science

S A Ewing, Head of Department

Professors: Anderson, Beitz, Brackelsberg, Burroughs, Christian, Ewan, Ewing, Foreman, Freeman, Haynes, Hoffman, Jacobson, Jurgens, Kiser, Kline, LaGrange, Lush, McGilliard, Nordskog, Owings, Parrish, Robson, Rust, Self, Sell, Speer, Stevermer, Stromer, Trenkle, Voelker, Warner, Wickersham, Willham, Wunder, Young, Zimmerman, Zmolek

Emeritus Professors: Arnold, Beresford, Lee, Melampy, Porter

Associate Professors: Berger, Brant, Ford, Hasiak, Holden, Kenealy, Olson, Rouse, Sebranek, Spike, Strohbehn

Assistant Professors: Kilmer, Rothschild, Russell

Instructor: Amundson

Undergraduate Study

For undergraduate curricula in animal science and dairy science, see *College of Agriculture, Curricula.*

The department offers the degrees Bachelor of Science in animal science, Bachelor of Science in dairy science, and complementary work toward admission to schools of law, medicine,

and veterinary medicine in either curricula This may be done while satisfying requirements for the degree Bachelor of Science in animal science or dairy science (see Index)

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with majors in animal breeding, animal nutrition, meat science, muscle biology, nutritional physiology, poultry nutrition, poultry products technology, physiology of reproduction, and molecular, cellular and developmental biology Minor work is offered in these areas to students taking major work in other departments For students desiring more general training, the degree Master of Science is offered in animal production In this program, additional course work may be substituted for a thesis

A strong undergraduate program is required for those students interested in graduate study Fundamental training in biology, chemistry, mathematics, and statistics is requisite to a satisfactory graduate program Graduate programs in animal science include supporting work in areas such as agronomy, anatomy, bacteriology, biochemistry, chemistry, economics, food technology, genetics, physiology, and statistics Students may choose graduate programs involving a co-major with one of these areas Graduate work in meat science is offered as a co-major in animal science and food technology

The department also cooperates in the interdepartmental program of Immunobiology (See *Index*)

The foreign language requirement, if any, is established on an individual basis by the program-of-study committee appointed to guide the work of the student

Open to graduate students for minor credit only 318, 319, 331, 352, 353, 360, 370, 415, 420, 423, 425, 427, 428, 429, 434, 436

Courses Primarily for Undergraduate Students

101. Animal Production. (5-0) 8 weeks Cr 3 S *For Winter Program in Farm Operation only* Farm animals in agriculture, the application of production, evaluation, and marketing principles Includes live animal demonstrations with cattle for meat and milk, horses, poultry, sheep, and swine

110. Orientation in Animal Science (1-0) Cr R F Orientation to the University and Department of Animal Science

114. Survey of the Animal Industry (3-0) Cr 3 F S SS Breeds, basic management and marketing of farm animals. Composition, evaluation, and marketing of animal products Includes live animal demonstrations with cattle for meat and milk, horses, poultry, sheep, and swine

210. Career Opportunities. (1-0) Cr R S *Prereq Sophomore classification in animal or dairy science* Detailed study and explanation of career opportunities in animal agriculture Suggested programs of study to acquire background knowledge for various careers

214. Basic Concepts of Animal Science. (2-2) Cr 3 F S *Prereq 114, Biol 110, Chem 163* Basic elements of anatomy, genetics, nutrition, physiology, and reproduction. Selection of breeding animals and evaluation of slaughter animals

218. Feeds and Feeding. (3-0) Cr 3 F S *For non-majors in animal or dairy science* Nutritional principles, digestive systems, composition and nutritional characteristics of common feedstuffs, ration formulation, and recommended feeding programs for farm animals Credit for both 218 and 319 may not be applied toward graduation

225. Our Livestock Heritage. (3-0) Cr 3 S An historic chronology of the influence of livestock on cultural evolution Comparative species heritage Contribution of livestock to the humanities

235. Dairy Cattle Performance. (1-2) Cr 2 F *Prereq 101 or 114* Origin and development of breeds Improvement and expansion programs Comparison of types and performance Influences affecting commercial use and adaptability of types and breeds Marketing of dairy cattle and milk.

305. Livestock Judging. (0-6) Cr 2 F S *Prereq 214, junior classification* Beef cattle, swine, horses, and sheep Fee for field trips

315. Horsemanship and Equitation. (0-4) Cr 2 F Fitting and training of light horses and ponies English and Western equitation and horsemanship Fee for field trips Lab fee

318. Fundamentals of Nutrition. (3-0) Cr. 3 F.S.SS *Prereq Organic chemistry or B B 221, physiology recommended, junior classification* Digestion and metabolism of carbohydrates, fats, proteins, minerals, and vitamins Measures of energy

319. Applied Animal Nutrition. (3-0) Cr 3 F S SS *Prereq 318* Essential nutritive requirements of livestock and poultry, sources and composition of nutrients, replacement value of feeds in rations, ingredient value of feeds in rations, ingredient identification, ration formulation, and feeding recommendations Credit for both 218 and 319 may not be applied toward graduation

331. Animal Reproduction and Lactation. (3-0) Cr 3 F S *Prereq Course in physiology* Comparative anatomy, physiology, and endocrinology of animal reproduction and lactation

332. Laboratory Methods in Animal Reproduction. (0-2) Cr 1 F S *Prereq Credit or classification in 331* Principles of artificial insemination in farm animals

335. Dairy Cattle Selection. (0-6) Cr 2 S *Prereq Sophomore classification* Selection of breeding animals for dairy herds Comparative terminology, decision making, and presentation of oral reasons Trips to dairy cattle farms Fee for field trips

352. Livestock Improvement Through Animal Breeding. (3-2) Cr 4 F S SS *Prereq Course in genetics recommended* The genetic and environmental bases of animal differences Selection and mating systems as mechanisms for genetic change Designing breeding programs for economically important traits Selection in a simulated breeding herd

353. Designing Breeding Programs for Livestock. (1-2) Cr 2 F *Prereq 352, Course in genetics* Evaluation of alternate breeding programs Multiple trait selection Merchandizing seedstock Computerized simulation and management decision aids Fee for field trips

360 Meat Animal Growth and Body Composition (2-2) Cr 3 F S *Prereq 214, Biol 110, B B 221 or organic chemistry* Prenatal and postnatal development of animal and poultry tissue with emphasis on muscle, fat and bone growth Evaluation of body composition for meat-producing animals Grades and pricing

370 Meat Science and Processing. (2-2) Cr 3 F S *Prereq 360* Physical, chemical, and biological conversion of muscle to meat Fundamentals involved in meat processing and preservation Techniques utilized for improving and maintaining high quality meat products for distribution and consumption Fee for field trips

371 Meat for Institutional Food Service. (1-3) Cr 2 S *Prereq F N 208, junior classification in institution management* Meat and poultry for hotel, restaurant and institutional use Structure, composition, cutting, preparation, selection, sanitation, portion control, cooking and carving Fee charged for field trips

400 Agriculture Travel Course Cr 3 SS *Prereq Junior or senior classification* Limited enrollment A American Tour, offered 1983 B International Tour, offered 1982 Students taking this course will also be required to register for Agron 400 for 3 credits Tour and study of production methods in major livestock and crop regions of the United States and other countries Influence of climate, soil, topography, markets, and other factors on livestock and crops produced Tour expenses paid by the student

410. Job Selection and Interviewing. (1-0) Cr 0 F *Prereq Senior classification in animal or dairy science* Seminar course designed to inform students of the professional areas in animal sciences and other agribusiness industries in which they may find employment opportunities Resume preparation and interviews

415. Horse Production. (2-2) Cr 3 S *Prereq 319 or 218, 352* Principles and concepts of horse genetics, breeding, reproduction, nutrition, behavior, training, stable management, and marketing Application of these concepts in pleasure horse production and use Fee for field trips Lab fee

420. Poultry Nutrition. (2-2) Cr 3 F *Prereq 319* Theoretical and practical aspects of poultry nutrition Ration formulation, mixing, and feeding tests Feeding programs and requirements at different ages

423 Poultry Production. (2-2) Cr 3 S *Prereq 319 or 218, 352* Practical feeding and management of chicken and turkey flocks Operational study of commercial farms, including production and marketing practices Fee for field trips

425. Pork Production. (2-2) Cr 3 F S *Prereq 319 or 218, 352* Life-cycle swine production Fee for field trips

427. Beef Production (2-2) Cr 3 F S *Prereq 319 or 218, 352* The beef industry Principal emphasis on cow-calf operations Postweaning production systems Fee for field trips

428. Cattle Feedlot Management. (2-2) Cr 3 F *Prereq 319, 352, 360* Preconditioning, selection and handling climatic control and seasonal influences, facilities, waste management, health and diseases, nutrition and feeding programs, production costs, marketing and carcass evaluation Fee for field trips

429. Lamb and Wool Production. (2-2) Cr 3 S SS *Prereq 319 or 218, 352* Calendarized farm flock program Programs for feeder lambs Fee for field trips

434. Milk Production. (3-0) Cr 3 F S *Prereq 319 or 218* Economics of milk production Facilities, feeding, management of the milking herd Nutritional relationships in milk secretion Raising herd replacements

436. Dairy Enterprise Planning. (2-2) Cr 3 S *Prereq 434* Independent student and team development of dairy production systems, cost analysis, budgets, and labor requirements Fee for field trips

475. Intercollegiate Judging Training and Competition A Cr 1-5 F S, B Cr 1-4 F S, C Cr 1-5 F S, D Cr 2 S *Prereq Admission by invitation*
A Meat Animals and Horses
B Dairy Cattle
C Meats
D Meat Animal Evaluation
Specialized training in evaluating and grading live animals and carcasses Fee for field trips

480. Animal Nutrition (2-0) Cr 2 S *Prereq Third-year classification in veterinary medicine curriculum* Nutrient requirements for animals, sources and composition of nutrients, ration formulation and feeding practices

490 Independent Study Cr 1 to 3 F S SS *Prereq Permission of the instructor* Open to juniors and seniors in animal science and dairy science showing satisfactory preparation for problems chosen Individual topic conference and preparation of report
A Animal Science
B Dairy Science
C Meat Science
D Senior Seminar
G Poultry Science
H Honors Program

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates.

500. Computer Techniques for Biological Research (2-2) Cr 3 S *Prereq Stat 401* Development of computing strategies for problem solving Constructing algorithms and organizing data for statistical program libraries

503 Seminar in Animal Production (1-0) Cr 1 F *Prereq Permission of instructor* Discussion and evaluation of current topics in animal production and management

505. Techniques in Animal Nutrition Experimentation (2-3) Cr 3 S *Prereq Stat 401* Planning, execution interpretation, and communication of nutrition research

510. Applied Animal Breeding. (2-0) Cr 2 Off campus, offered as requested *Prereq 352* Principles of animal breeding; application to improvement of domestic animals Heritability, genetic and phenotypic correlations, selection indexes, sire and dam evaluation, and breeding program design Designed for Master of Agriculture Program only

511. Applied Ruminant Nutrition. (2-0) Cr 2 Off campus, offered as requested *Prereq 319* Procedures and theories in beef, dairy, and sheep nutrition Feeding programs and requirements for lactation, growth, and reproduction Designed for Master of Agriculture Program only

512 **Applied Non-Ruminant Nutrition.** (2-0) Cr 2 Off campus, offered as requested *Prereq 319* Recent developments and application of basic nutritional concepts for swine and poultry production Selected aspects and concepts of computer diet formulation Designed for Master of Agriculture Program only

518. **Advanced Farm Animal Nutrition.** (5-0) Cr 5 F *Prereq 319* Nutritional requirements for reproduction, production, lactation and growth, feeding programs, and current research for farm animals

533 **Physiology and Endocrinology of Animal Reproduction.** (V P P 533) (3-0) Cr 3 S *Prereq General physiology course* Development of structure and function of the reproductive system Physiologic and endocrine aspects including puberty, gametogenesis, estrous cycle, pregnancy, parturition, interaction of environment, thyroid and adrenal function, and nutrition with these processes

550 **Population Genetics.** (Gen 550) (3-0) Cr 3 S *Prereq Stat 401* Statistical methodology in the study of population genetics Concepts of a population Study of qualitative and quantitative population genetics including equilibrium and dynamic populations

570. **Advanced Meat Science and Applied Muscle Biology** (2-2) Cr 3 S *Prereq 370* Chemistry and microscopic structure of muscle tissue. Post-mortem changes in muscle and their relationship to muscle as a food Palatability and processing characteristics and factors affecting these characteristics Laboratory practice and experimentation

590 **Special Topics.** Cr 1 to 3 F S SS *Prereq Permission of instructor* Special topics in the animal sciences, offered on demand and often conducted by guest professors
A Animal Breeding
B Animal Nutrition
C Meat Animal Production
D Dairy Production
E Meat Science
F Physiology of Reproduction
G Muscle Biology
H Poultry Nutrition
I Poultry Products
J Experimental Surgery
K Professional Topics

Courses for Graduate Students, major or minor.

603. **Seminar in Animal Nutrition** (1-0) Cr R F S *Prereq Permission of instructor* Discussion of current literature, preparation and submission of abstracts

610. **Ruminology.** (3-0) Cr. 3. Alt. S., offered 1982 *Prereq Permission of instructor* Anatomy and physiology of the ruminant digestive tract Description and metabolism of ruminal and intestinal microbes Utilization of end-products absorbed from tract Abnormal rumen function

618. **Advanced Nutrition — Minerals and Vitamins.** (3-0) Cr 3 F *Prereq B B 405* Role of vitamins and minerals in mammalian intermediary metabolism Integration of cellular biochemistry and physiology of vitamins and minerals

619 **Advanced Nutrition — Protein** (2-0) Cr 2 S *Prereq B B 405* Digestion, absorption, and intermediary metabolism of amino acids and protein Integration of cellular biochemistry and physiology of mammalian protein metabolism

620 **Advanced Nutrition — Energy** (2-0) Cr 2 S *Prereq B B 405* Energy constituents of feedstuffs and energy needs of animals as related to cellular biochemistry and physiology Interpretations of classical and current research

633. **Seminar in Animal Reproduction.** (1-0) Cr 1 F *Prereq Permission of instructor* Discussion of current literature and preparation of reports on selected topics concerning physiology of reproduction

651. **Methodology in Animal Breeding.** (3-0) Cr 3 F *Prereq 550, Stat 402.* Techniques and statistical tools useful in animal breeding theory and application Correction for environmental effects, estimation and interpretation of components of variance, heritabilities, genetic correlations, and their standard errors Kinds of selection index theory

652. **Population Dynamics in Animal Breeding.** (2-2) Cr 3 S *Prereq. 651* Population size, inbreeding, selection intensity, and selection schemes as they affect rate of genetic change in farm animals Conditions for optimum change, genetic limits, and equilibria.

653. **Applied Poultry and Swine Breeding.** (2-0) Cr 2 Alt S., offered 1982 *Prereq 651* Industrial application of breeding systems, selection methods, inbreeding, and hybridization

654 **Applied Beef and Dairy Cattle Breeding.** (2-0) Cr 2 Alt S., offered 1983 *Prereq 651* Industrial application of breeding systems, sire selection and evaluation, and crossbreeding

670. **Molecular Biology of Muscle** (B B 670) (3-0) Cr 3 Alt F., offered 1982 *Prereq B B 405, 420, or 502* Microstructure and chemical composition of muscle tissue Chemistry, function, and turnover of muscle and connective tissue protein Molecular aspects of muscle contraction

680. **Modern Views of Nutrition** (F N 680) (2-0) Cr R S Current concepts in nutrition and related fields Required for all graduate students in nutrition

684 **Seminar in Meat Science.** (1-0) Cr 1 S *Prereq Permission of instructor* Discussion and evaluation of current topics in research publications in meat science

685 **Seminar in Muscle Biology** (1-0) Cr 1 S *Prereq Permission of instructor* Reports and discussion of recent literature and current investigations

699. **Research**
A Animal Breeding
B Animal Nutrition
C Meat Animal Production
D Dairy Production
E Meat Science
F Physiology of Reproduction
G Muscle Biology
H Poultry Nutrition
I Poultry Products

Anthropology

Administered by the Department of Sociology and Anthropology

Dennis M Warren, Coordinator

Professors: Gradwohl, Warren, Whiteford

Associate Professors: Bower, Schuster

Assistant Professor: Huang

Undergraduate Study

Within the Department of Sociology and Anthropology an undergraduate major in anthropology can serve as the nucleus for a general liberal education, or as the prerequisite for a graduate training qualifying a person for positions in (1) college and university teaching, (2) research, and (3) administrative and applied positions in government and museums Fields of anthropology are cultural anthropology (ethnology, social anthropology, archaeology, psychological anthropology, and linguistic anthropology), and physical anthropology (human biological evolution, constitution, and modern variations) Undergraduate students may obtain experience in archaeological and ethnological research

Anthropology majors may choose either a Bachelor of Arts or a Bachelor of Science degree A Bachelor of Arts degree is obtained by fulfilling the college general education requirements plus 6 additional credits in Groups I, II, and/or IV A Bachelor of Science degree is obtained by fulfilling the college general education requirements plus 6 additional credits in Group III.

Undergraduate students with majors in anthropology usually include the following courses in their program 111, 218, 219, 220, and 221. One year of a foreign language is required Excellent supporting courses directly related to anthropology will be found in sociology, psychology, zoology, genetics, history, political science, philosophy, earth sciences, and economics. Undergraduates majoring in anthropology may elect these areas or others as minors. Anthropology majors may elect a second major in international studies. Undergraduates majoring in sociology and majors outside the department may minor in anthropology

The principal subdisciplines of anthropology are represented by the following:

1 General cultural anthropology and ethnology: 111, 218, 310, 311, 313, 321, 322, 323, 324, 327, 332, 333, 335, 340, 350, 490B

2 Archaeology 220, 320, 334, 420, 426, 428, 429, 490A

3 Linguistic anthropology: 221, 490D

4 Physical anthropology: 219, 490C

Graduate Study

The Department of Sociology and Anthropology offers the degree Master of Arts in Anthropology Graduate courses are given in the areas of biological anthropology, archaeology, sociocultural anthropology, linguistic anthropology, history and theory, and methodology. Competence in one foreign language and in statistics is to be demonstrated A thesis, generally based on original fieldwork, is required

Courses open to graduate students for minor credit only: 420, 426, 428, 429

Courses Primarily for Undergraduate Students

111. **Introduction to Anthropology.** (3-0) Cr 3 F S SS Introduction to the comparative study of humankind through time and cross-culturally, survey of the concepts, methods, and findings of anthropology within the framework of its major subdivisions the biological (physical anthropology, including human origins and primate studies) and the cultural (socio-cultural anthropology, including archaeology and linguistics)

218. **Cultural Anthropology.** (2-2) Cr 3 S.SS *Prereq. 111* Study of humanity in sociocultural perspective Anthropological concepts and techniques in interpreting world cultural similarities and differences Institutional basis of human behavior, including family and kinship, economic, political and belief systems in developmental and cross-cultural perspectives Participatory lab with focus on anthropological fieldwork techniques

219. **Physical Anthropology.** (2-2) Cr 3 S. *Prereq 111* Human evolution as known from fossil evidence, comparative primate studies, and genetic variations in living populations Laboratory-tutorial sessions include study and discussion of human osteology, fossil hominids, simple Mendelian traits, and bio-ethics in applied physical anthropology Fee

220. **Archaeology.** (3-2) Cr 4. F. *Prereq: 111.* Nature of archaeological evidence, its recovery and use in reconstructing human behavior and environments of the past Field trip provides participatory experience in data collection Laboratory-tutorial sessions include study and discussion of classification systems, stone tool manufacture, ceramic technology, and ethics in public archaeology Fee

221. **Linguistic Anthropology.** (2-2) Cr 3. F *Prereq. 111* Nature and development of human language capabilities, biological basis of human language acquisition; language learning among non-human primates; language and epistemological aspects of cultural systems Cross-cultural study of language and communication, structural and transformational linguistics. Participatory lab; focus on linguistic analysis as a tool for anthropological fieldwork. Fee.

310. **Psychological Anthropology.** (3-0) Cr. 3. Alt. S., offered 1983. *Prereq: 218.* Relationship of cultural, social, and personality factors in human behavior with emphasis on cross-cultural comparisons; history of the field, theories of child rearing and personality development; relationship between social structure and personality, between mental health and culture; application of anthropological research methods to the study of socialization, deviance, ethno-psychiatry, and culture change

311. Culture Change and Applied Anthropology. (3-0) Cr 3 F *Prereq. 218* Theoretical and practical considerations of human cultural development Examination of cultural theories of change Culture contact and acculturation Dynamics of directed change in contemporary world cultures Principles, theories, and ethics of international development projects from a sociocultural perspective

313. The Family and Kinship in Cross-Cultural Perspective. (3-0) Cr 3 S. *Prereq 111* Comparative and historic study of the family, household, residential, and extended kinship groups in cross-cultural perspective, discussion of the structure, cycle, and functioning of family and kinship systems, including "family" as conceptualized in our culture, socialization within the family in various cultures

320. World Prehistory. (3-0) Cr 3 Alt F, offered 1981 *Prereq 111* Survey of the archaeological record for each of the world's major regions Emphasis on comparing causes, consequences, and ecological settings of major cultural developments, such as food production and the rise of civilizations

321. Comparative Studies of World Cultures. (3-0) Cr 3 F *Prereq 111* Comparative survey of essential features of world's major societal types Examination of social institutions among hunting-and-gathering peoples, tribal groups, peasant and post-peasant societies, emphasis on comparative method

322. The American Indian. (Am In 322) (3-0) Cr 3 F SS *Prereq 111* Origin and distribution of native peoples of North America, survey of culture areas, examination of the natural setting, ecology and subsistence, language, kinship, political, economic, and religious systems, life cycle and personality for various indigenous peoples, historic contact and acculturation within culture areas

323. Contemporary Latin American Cultures. (Am In 323) (3-0) Cr 3 S *Prereq 111* Origin and distribution of native populations, blending of Old and New World cultures, theoretical problems of peasant and tribal societies, discussion of economic, social, political, and religious systems processes of change

324 Peoples and Cultures of the Old World (3-0) Cr 3 F *Prereq 218* Selected Old World Cultures One of the following regions will be offered each year

A Africa
B Europe
C Near East
D Asia
E Oceania

327. Ekistics, The Science of Settlement Behavior (3-0) Cr 3 Alt F, offered 1981 *Prereq 111* Spatial arrangements of people and facilities in ecological and evolutionary perspective, proxemics, cross-cultural exploration of settlement systems and traditional dwellings, applications

332. Contemporary Native Americans. (Am In 332) (3-0) Cr 3 S *Prereq 111, 322 recommended* Conditions and issues of contemporary Native Americans as seen against the ethnohistoric background of eighteenth and nineteenth century Indian-White relationships, examination of treaties, legal status, the reservation system, laws, acts, and congressional policy, Red Power, Pan-Indianism, urbanization, self-determination, and other current concerns

333. Anthropological Perspectives on Black America. (3-0) Cr 3 Alt S, offered 1982 *Prereq 111* Anthropological approaches to the study of Afro-American culture in historical and cross-cultural perspectives African heritage of Black American culture, development of ethnic identity and confrontations, pluralistic and stratified social systems, contemporary ethnography of Afro-Americans in North, Middle, and South America

334. Archaeology of Africa. (3-0) Cr 3 Alt S, offered 1983 *Prereq 111* Prehistory and ethnoarchaeology in Africa with emphasis on sub-Saharan regions Relationship between human fossil record and early cultures, archaeological contributions to language history, links between prehistoric and contemporary cultures

335. Economic and Political Anthropology (3-0) Cr 3 Alt S, offered 1983 *Prereq. 111, 218* Economic and political developments among non-Western cultures, comparative socio-cultural analysis of production, distribution, and consumption patterns in historical and contemporary perspective, international frameworks of dependency, underdevelopment, and development economics from a socio-cultural perspective

340. Anthropological Perspectives on Religion. (Relig 340) (3-0) Cr 3. Alt. S., offered 1982 *Prereq 111* Origin and development of indigenous magico-religious systems, myth and ritual, therapeutic aspects, symbols and meanings, religion and socio-cultural change, including acculturation, nativistic, and revitalization movements

350. Ethnography of the Visual Arts. (3-0) Cr 3 Alt S, offered 1982 *Prereq 111* Survey of the visual arts of non-Western societies in Africa, Oceania, and the Americas, description of stylistic areas; art as cultural symbol, emphasis on the role of the artist and the function of the visual arts within particular cultural settings

420. Archaeology of North America. (Am In 420) (3-0) Cr 3 Alt F, offered 1982 *Prereq 220, or 320, or 322* Prehistory and early history of North America as reconstructed from archaeological evidence, peopling of the New World, culture-historical sequences of major culture areas north of the Rio Grande, linkages of archaeological traditions which selected ethnohistorically known Native American groups

426 Archaeology of Europe and the Near East. (3-0) Cr 3 Alt S, offered 1982 *Prereq 220 or 320* Ancient Europe from Paleolithic cultures to early literate societies as reconstructed from archaeological evidence prehistoric background of Near Eastern and Mediterranean civilizations and their relationships to European peoples up to the time of the Roman empire

428. Archaeological Laboratory Methods and Techniques. Cr 3 Alt S, 1983 *Prereq 220, permission of instructor* Individual and/or group projects including laboratory processing and analysis of archaeological materials, experiments in technologies such as manufacture of stone tools or ceramics, writing a preliminary site report, design and preparation of a museum display

429. Archaeological Field School. Cr 8 to 10 SS 8 to 10 weeks *Prereq 220, permission of instructor* Summer field school for training in archaeological reconnaissance and excavation techniques, documentation and interpretation of archaeological evidence

490 Independent Study Cr 1 to 5 each time taken *Prereq 9 credits in anthropology*

A Archaeology
B Cultural Anthropology
C Physical Anthropology
D Linguistic Anthropology
H Honors

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

500 Language and Culture. (3-0) Cr 3 Alt S, offered 1983 *Prereq 221* Structure and design of language, functional relationships between language, cognition, and culture, linguistic change, social and linguistic aspects of verbal behavior, language, world view, and cognitive style

503 Primate Evolution. (3-2) Cr 4 Alt S, offered 1983 *Prereq 219 or Zool 206L* Comparative studies of the morphology and behavior of primates in neontological and paleontological perspective Laboratory analysis of locomotor adaptations and variability in habitus and heritage, limb bones, muscles and fossil casts Fee

505. Urban Anthropology. (3-0) Cr 3 Alt F, offered 1982 *Prereq 6 credits in anthropology* Origins of urbanism, patterns of urban growth, migration to cities; effects of urbanization processes on the countryside

510 Contemporary Sociocultural Anthropology (3-0) Cr 3 Alt F, offered 1982 *Prereq 6 credits in anthropology* Survey of current developments in topical approaches to sociocultural anthropology Examination and assessment of controversies, new research directions, quantitative and qualitative methods, formulation of research paradigms for advanced studies

520. Cultural Continuity and Change in the Prairie-Plains. (Am In 520) (3-0) Alt F, offered 1981 *Prereq 322, or 420, or 429* Ecological adaptations, sociocultural changes, and continuities of traditions among Prairie and Plains Indian groups through time, impacts of Euro-American society and technology on Indians of the Great Plains, perspectives from ecology, archaeology, ethnology, history, and contemporary literary sources

522. Seminar on American Indians. (Am In 522) (3-0) Cr 3 Alt F, offered 1982 *Prereq 322 or 332* Research and discussion of selected topics on contemporary and/or traditional Native American cultures

529. Advanced Archaeological Methods. Cr 1 to 5 F S SS May be taken for 8 to 10 credits in summer field school *Prereq 429, permission of instructor* Archaeological field techniques and laboratory methods Reconstruction of sociocultural activities from archaeolgical evidence

530. Field Problems in the Ethnology of Contemporary Societies. Cr 3 to 5 Alt F, offered 1981 May be taken for 8 to 10 credits in summer field school *Prereq 6 credits anthropology, permission of instructor* Field training experience in ethnography Problems emphasizing field studies in the contemporary societies of the world

533. Medical Anthropology. (3-0) Cr 3 Alt F, offered 1981 *Prereq 6 credits in anthropology* Study of human health in cultural and environmental context, comparison of health and disease patterns of western and non-western populations, use of epidemiological models in understanding illness and disease etiologies cross-culturally, interrelationship between diet and culture

555. Seminar in Archaeology. (3-0) Cr 3 Alt S, offered 1982 *Prereq 320, or 334, or 420, or 426, or 429* Critical review and examination of traditional and contemporary methods and theories involved in the study of human behavior in the past

560 Topical Studies in Anthropology (3-0) Cr 3 each time taken *Prereq 6 credits in anthropology, permission of instructor* Graduate study in conjunction with a 300- or 400-level course in the topics listed below May not be taken in conjunction with a 300- or 400-level course in which the student has previously earned credit

A Religion
B Kinship
C Psychological
D Culture Change
E Ekistics
F Archaeological
G Economic
H Visual Arts

561 Regional Studies in Anthropology (3-0) Cr 3 each time taken *Prereq 6 credits in anthropology, permission of instructor* Graduate study in conjunction with a 300- or 400-level course in the areas listed below May not be taken in conjunction with a 300- or 400-level course in which the student has previously earned credit

A North American Indian Ethnology
B North American Archaeology
C Latin American Ethnology
D African Ethnology
E African Archaeology
F European Ethnology
G Near Eastern Ethnology
H European and Near Eastern Archaeology
I Asian Ethnology
J Oceanian Ethnology

590 Special Topics. Cr 1 to 5 *Prereq 10 credits in anthropology, senior or graduate classification*

598. Advanced Topics in Anthropology (3-0) Cr 3 each

599 Research

Architecture

, Chair of Department

Professors: Greenfield, Heemstra, Kainlauri, Kitzman, McKeown, Shank, Shao, Slater, Stone, Woods

Emeritus Professors: Kocimski, Patten

Associate Professors: Block, Findlay, Lorr, Masterson, Mukerjea, Nayman, Overton, Robinson, Saccopoulos, Toporek, Young

Assistant Professors: Bricken, DeKovic, Frey, Gami, Hawk, Iber, Maves, Miller, Osterberg, Roseland, Tiernan

Instructor: VeVerka

Undergraduate Study

For curriculum in architecture leading to the degrees of Bachelor of Arts and Bachelor of Architecture, see *College of Design, Curricula*

The undergraduate curriculum in the Bachelor of Arts in Architecture program provides the academic introduction to the field of architecture and to the peripheral field of environmental design While the Bachelor of Arts in Architecture degree is not a professional degree, it is intended to assist students in ultimately pursuing any one of several alternative careers by encouraging them to follow their particular interests and aptitudes, both in depth and in breadth, and to explore many potentially valuable roles related to the building environment

The degree Bachelor of Arts in Architecture is awarded upon successful completion of the 127 5 credit program

The Bachelor of Arts in Architecture degree prepares the student for further studies leading to the first professional degree, either the Bachelor of Architecture or the Master of Architecture Qualified students seeking registration as an architect are advised to undertake one of these professional degree programs

Students are encouraged to seek practical experience in professional settings during summer vacations and/or prior to undertaking graduate studies Admission to the Bachelor of Architecture program will be based upon the qualifications of the applicants and upon available resources in the department

A fee will be assessed when field trips are indicated Other course, laboratory, and/or studio fees may also be required

An optional one-semester foreign study program may be offered depending on available resources in the department

Graduate Study

The department offers several graduate programs leading to the professional degree Master of Architecture with major in architecture Minor work is offered to students taking major work in other departments

The programs leading to the Master of Architecture degree are designed to educate professional architects to work effectively within contemporary constraints, to comprehend continuing changes within our society, and to formulate concepts for a better human environment

The programs of study are

Program 1. A 30-graduate-credit program for those holding the degree Bachelor of Architecture

Program 2 A 60-credit program for those holding the degrees B A or B S in architecture or environmental design

Program 3. A program of more than 60 credits tailored to the experience, training, and education of students with other baccalaureate degrees

In programs 2 and 3, a minimum of 40 credits must be graduate credits.

It is possible to arrange a program of study for the Master of Architecture degree on a non-thesis basis

Admission to the graduate programs will be based on the qualifications of the applicants and on available resources in the department

The Master of Architecture degree program following the degree Bachelor of Architecture shall include

Cr.	
2	Arch 501
10	Thesis or terminal studio*
18	Electives
30	Total credits

The Master of Architecture degree program following the degree B A or B S in architecture or environmental design shall include

Cr.	
2	Arch 501
10	Arch 605, 606
3	History, theory and criticism options**
6	Building sciences options***
10	Thesis or terminal studio*
12	Concentration****
17	Electives****
60	Total credits

All graduate programs require the guidance of a graduate program of study committee

An optional one-semester foreign study program may be offered depending on available resources in the department

The department also participates in the interdepartmental programs in Energy Systems Engineering and Housing (See *Index*)

Open to graduate students for minor credit only 421, 422, 423, 424, 425

*Not more than 5 additional credits may be drawn from elective credits as needed for thesis work to be approved by major professor and program of study committee. The terminal studio is a faculty approved creative component which meets the Graduate College requirements

**Student's choice from among a faculty approved list of courses

***For the first professional degree, B. Arch. or M. Arch, 10 credits in structures and 12 credits in architectural technologies are required. These 22 credits will include the 16 credits taken in structures and architectural technologies under Building Sciences in the B.A. in Architecture program. Student's choice from among a faculty approved list of courses

****To be approved by major professor and program of study committee

Courses Primarily for Undergraduate Students

200. Systems of Visual Order. (1-6) Cr 3 F S SS *Prereq Dsn S 140* The concept of order as applied to architecture Perception of space and form Elements of design Studio projects in defining and solving visual problems Field trip Fee

204. Three-Dimensional Studio. (Art 204) (0-6) Cr 2 each time taken F S Investigation of basic sculptural media, modeling in clay, wood carving, stone carving, casting in plaster and metal, welding, and other constructing techniques No more than 8 credits may be applied toward a degree in architecture for the sum of credits earned in 204 and 533

211 Computer Applications. (2-2) Cr 3 S Survey of computer applications in architecture and environmental design Current and potential applications of digital computers in architecture and related design professions Programming languages related to applications Field trip Fee

235. Drawing I. (0-6) Cr 2 F S *Prereq: Dsn S 140* Freehand drawing as a design tool conceptualization, development, refinement, and presentation. Introduction to basic objective drawing techniques. Scale, depth clues, space division, with emphasis on linear perspective as applied to architecture Fee

236. Drawing II. (Art 236) (0-6) Cr 2 F S *Prereq: 235 or Art 235* Freehand drawing as a design tool conceptualization, development, refinement, and presentation Includes the human figure in relation to architectural space, and scale Fee

305, 306, 405, 406. Architectural Design. (1-12) Cr 5 each F S *Prereq 305 200, 235, 306. 305, 405 or 406:* *306, 311, 312.* An integrated series in architectural design Human, environmental and technical factors Process, form, and communication Architectural systems Studio work in solving of architectural problems of increasing scope. Field trips. Fee.

311. Introduction to Architectural Technologies I. (3-0) Cr 3 F *Prereq: Permission of instructor.* Qualities, properties, and other characteristics of materials used in architectural construction Process of selection, organization, evaluation, and integration of materials into site and design concepts. Overview of structural systems. Field trip. Fee

312. Introduction to Architectural Technologies II. (3-0) Cr 3 S *Prereq: Permission of instructor* Concepts of control of thermal, luminous, and acoustic environments. Overview of plumbing, mechanical, and electrical systems. Concepts of energy and environmental impact. Field trip. Fee.

321. History of Western Architecture. (3-0) Cr 3 F S Introductory survey from ancient to modern times. Relationship to the culture, the visual arts, the site, and the surroundings.

332. Two-Dimensional Studio. (Art 332) (0-6) Cr 2 each time taken F S Investigations in visual design through the medium of studio painting Emphasis on materials, techniques, and color/shape relationships with consideration for their expressive, decorative, and optical potentials No more than 8 credits may be applied toward a degree in architecture for the sum of credits earned in 332 and 532.

360. Residential Architecture. (3-0) Cr 3. F.S. A survey of social, economic, and environmental parameters related to residential architecture Fundamentals of planning and design of dwellings.

372. Architectural Programming. (3-0) Cr 3 F S *Prereq 305* Programming space needs through problem analysis as a prelude to the design process

373. Methods of Inquiry in Architectural Design. (3-0) Cr. 3 F S *Prereq 305.* Overview of methods of inquiry from common sense to rigorous scientific procedures related to architectural design processes

407, 408. Architectural Design. (0-15) Cr 5 each 407 F , 408: S *Prereq Admission to B. Arch program* Architectural design problems of increased complexity

421, 422, 423, 424, 425 History, Theory, and Criticism of Architecture. (3-0) Cr 3 each 421 Alt S , 422 F , 423 S , 424 F , 425. F S *Prereq for each 321* An integrated study of the history, theory, and principles of architecture and urban design considering relationships to the culture, visual arts, site, and surroundings Field trips Fee 421 Ancient. 422 Medieval 423 Renaissance to mid-eighteenth century 424 Nineteenth century 425. Twentieth century

430. Drawing III. (0-6) Cr 2 each time taken F S *Prereq. 235* Advanced freehand drawing as an architectural design tool Studio problems including human figure, natural environment, built form, space-scale relationships, perspective, and rendering techniques Fee

431. Advanced Architectural Graphics I. (0-6) Cr 2 F S *Prereq: 235, Fr E 146.* Applied principles of graphic renderings, such as tonality interactions, scale interpretation, environmental illusionary symbols (trees, people, objects), spatial illusion, applied perspective relationships, and perceptual implications of natural visual phenomena to graphic illusion techniques. Simple limited graphic media

432. Advanced Architectural Graphics II. (0-9) Cr 3 F S *Prereq. 431* Exploration of a variety of visual graphic rendering media in applications of the principles of Arch 431 and explorations of combinations of visual presentation media.

434. Introduction to Computer-Aided Architectural and Environmental Design. (3-0) Cr 3 F *Prereq: 211, a design course, permission of instructor* Application of the computer as a design tool Topical applications and computer graphic methods. Development of computer software for architectural and environmental problem solving. Field trip. Fee.

435. Visual Studies in Architecture: Computer-Aided Design. (1-3) Cr 2 S. *Prereq: Senior classification, permission of instructor.* Studio problems involving the computer as a permutative, analytical, and synthesizing tool Participation in design projects with emphasis on individual student interest.

466. Multi-Family Housing. (3-0) Cr 3 F S. *Prereq: Senior classification.* Historical survey of private and publicly provided multi-family housing types, including utopian and future projections for housing. Field trip. Fee

467. Restoration and Renovation of Existing Structures. (3-0) Cr 3 S *Prereq Senior classification* Economic and architectural considerations of remodeling and adaptive re-use of existing structures

468. Energy Analysis of Residential Structures. (3-0) Cr 3 S *Prereq 306, 1 semester of physics* Architectural design and technical analysis of residential structures that emphasize energy construction and solar energy utilization Field trips Fee Meets concurrently with Phys 351

471. Design Methods Seminar. (3-0) Cr 3 S *Prereq. 306* Investigation of the discipline of design Methods and procedures studied as a unified process with emphasis on design cycles, systematic analysis, and conceptual development

473. Man-Environment Relations (3-0) Cr 3 S *Prereq 305* An exploration of theories of environmental design relating human behavior to various physical settings Techniques of environmental analysis through field investigations

490. Independent Study F S SS Cr 2 to 9 *Prereq Written approval of instructor and department head* Investigation of problems of special interest to the student
H Honors

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

501 Seminar. (2-0) Cr 2 F S Professional philosophy Investigation of traditional and new roles in architectural practice

502. Seminar (1-0 to 3-0) Cr 1 to 3 each time taken F S Investigation of the changing relationships between professional practice and the needs of society

507. Urban Housing Studio. (0-18) Cr 6 F S *Prereq Admission to the B Arch or graduate program* Design of moderate to high density housing in urban environments

508 Urban Design Studio (0-18) Cr 6 F S *Prereq Admission to the B Arch or graduate program* Urban design processes applied to contemporary urban settings

509 Environment-Behavior Studio (0-18) Cr 6 F S *Prereq Admission to the B Arch or graduate program* Solving physical environment problems through the analysis of human behavior

511 Architectural Luminous Environment. (3-0) Cr 3 F *Prereq 311, 312* Natural and artificial lighting Visual stimuli, comfort, discomfort, perception, and active and passive systems of control Field trip Fee

512 Architectural Thermal Environment. (3-0) Cr 3 F S *Prereq 311, 312* An integration of the concepts of thermal stimuli, comfort, discomfort, active and passive systems of control Field trip Fee

513. Architectural Acoustic Environment. (3-0) Cr 3 S *Prereq 311, 312* An integration of the concepts of acoustic stimuli, comfort, discomfort, active and passive systems of control Field trip Fee

514 Sanitary Systems. (3-0) Cr 3 F *Prereq 311, 312* An integrated study of the principles of drainage, water supply and treatment Systems pertaining to sites and buildings Field trip Fee

515. Concepts in Building Fire Safety (3-0) Cr 3 S *Prereq 306, 311, 312 or M E 440 or M E 442* Theory of fire behavior, site planning for fire apparatus, materials, construction, detection, suppression, escape and refuge, codes as they relate to architecture Field trip Fee

516. Construction Methods. (3-0) Cr 3 F *Prereq 311, 312, or M E 440 or M E 442* Advanced studies of construction methods and procedures Field trip Fee

517. Advanced Studies in Building Systems. (3-0) Cr 3 S *Prereq 512 or M E 440 or M E 442* Integration and development of technical building systems Field trip Fee

521. Topical Studies in History, Theory, and Criticism of Architecture. (3-0) Cr 3 each time taken F S *Prereq Permission of instructor* Field trips Fee
A Pre-Modern
B Modern
C American
D Oriental and other non European
E Architects
F Historic Preservation
G Technical, Structural, and Programmatic
I Urban Design

532. Advanced Two-Dimensional Studio. (0-6) Cr 2 each time taken F S *Prereq 332* Advanced studies in visual design Emphasis on materials, techniques, scale, and color/shape relationships Potential of expressive, decorative, and optical effects for independent and architecturally integrated projects No more than 8 credits may be applied toward a degree in architecture for the sum of credits earned in 332 and 532

533. Advanced Three-Dimensional Studio. (0-6) Cr 2 each time taken F S *Prereq 204* Advanced investigation of sculptural expression with emphasis on individual interest No more than 8 credits may be applied toward a degree in architecture for the sum of credits earned in 204 and 533

541 Human Thermal Environments (M E 541) See *Mechanical Engineering*

543 Office Practice. (3-0) Cr 3 S *Prereq 311, 312, 306 or I Ad 315* Contracts, documents, specifications, working drawings, office procedures, and administration Field trip Fee

544 Advanced Topics in Architectural Technologies. (3-0) Cr 3 each time taken F S Prereq 311, 312 Field trip Fee
A Materials
B Structural Systems
C Conveying Systems
D Industrialized Building Systems and Components
E Alternative Energy Systems
F Appropriate Technology

556. Case Studies in Architecture (3-0) Cr 3 S *Prereq 3 semesters of design* In-depth investigations of specific, real-world problems of architecture or building utilizing the case method approach, includes interviewing design professionals, clients, and users and analyzing data found in construction documents and reports Extensive documented final report

566 Housing the Elderly, Disabled, and Low-Income (3-0) Cr 3 F *Prereq Admission to the B Arch or graduate program* Social, psychological, and economic parameters of residential architecture for independent and institutionalized persons

572 Advanced Architectural Programming. (3-0) Cr 3 F *Prereq 372* Determination of space, site and cost factors for design Procedures methods and techniques

573 Post-Occupancy Evaluation (3-0) Cr 3 S *Prereq Admission to the B Arch or graduate program* Methods of evaluating the physical, social, and psychological performance of buildings following construction and occupancy, with emphasis on behavioral response to the environment and its role in the design process

574 Real Estate Investment Aspects of Architecture (3-0) Cr 3 S *Prereq 405 or 406* Principles of real estate investment and an analysis of their influence on architectural design Field trip Fee

576 Research Methods for Environmental Designers. (3-0) Cr 3 F *Prereq Admission to the B Arch or graduate program* Examination of qualitative and quantitative methods of inquiry with specific application to environmental design

577 Social Impact of the Physical Environment. (3-1) Cr 4 S *Prereq Admission to the B Arch or graduate program* Interdisciplinary review and analysis of social scientific research applied to architectural design

585. Contemporary Urban Design Theory (3-0) Cr 3 F S *Prereq Admission to the B Arch program or graduate program* Current urban design theory and its application to urban problems

590 Special Topics. Cr 1 to 5 each time taken F S SS *Prereq Written approval of instructor and department head* Projects of special interest to the student

Courses for Graduate Students, major or minor

605, 606 Architectural Design. (0-15) Cr 5 each 605 F 606 S *Prereq Admission to M Arch program* Architectural design problems of increased complexity

607. Advanced Architectural Design. (0-15) Cr 5 F S *Prereq Professional degree in architecture* Architectural design problems of increasing complexity

608. Individual Design Projects. (0-9 to 0-36) Cr 3 to 12 each time taken F S *Prereq Approval of major professor*

699. Research. Cr Var F S SS

Art and Design

Jon H Sontag, Chair of Department

Professors: Allen, Danielson, Fenimore, Gottfried, Heggen, Held, Meixner, Miller, Pickett, Sontag

Emeritus Professors: Adams, Gartield, Petersen, Watson

Associate Professors: Bro, Dake, Evans, Fowles, McIlrath, Polster, Townsend, Warme, Zimmerman

Assistant Professors: Baer, Benitez, Figura, Friedman, Hromyak, McClain, Morgan, Shouse Shull, Smith, Sreenivasam, Stout, Tilden, Tow Weinkein

Instructors: Camp, Hedrick, Molison, Paape

Undergraduate Study

For undergraduate curricula in art and design leading to the degrees Bachelor of Arts and Bachelor of Fine Arts, see *Design, Curricula*

The department offers work for the degree Bachelor of Arts in advertising design, art education, craft design, general art, and interior design and work for the degree Bachelor of Fine Arts in art and design

I. **Advertising Design.** This curriculum prepares students for positions in graphic design, for work requiring imagination and skills in the layout and design of communication media that will express concept and purpose with clarity and style

II. **Art and Design.** This curriculum is planned for students who desire a strong professional concentration within the Department of Art and Design Students must make application and be admitted by a department committee A portfolio review is also required

III. **Art Education.** This curriculum is planned for students preparing for certification to teach art in grades kindergarten through twelve Students may enroll in art education Students must make application to and be accepted by the teacher education committee in the Department of Art and Design and the University Committee on Teacher Education The program outlined for art education is under the College of Design, Department of Art and Design For general requirements for teacher certification, see *College of Education*

IV **Craft Design.** This curriculum provides for a general knowledge of the craft areas and a possible concentration in an area of the student's choice clay, metal, structural fiber art surface design on fabric, or wood The student gains a concentrated background preparing for careers such as marketing crafts, free lance design, or teaching in community education

V. **General Art.** This curriculum provides students with a liberal education in the visual arts A strong general education is provided with the art and design foundations, an art concentration, recommended minor area, and electives Options for minors may include film, literature, music, theater, period minors, or individual minors designed within departmental guidelines

VI. **Interior Design.** This curriculum is planned for art students who plan to enter the professional field of interior design

Graduate Study

The department offers work for the degree Master of Arts in art and design and minor work to students taking major work in other departments Within art and design, the graduate student may specialize in advertising design, art education, craft design, and interior design

A student in the graduate program may select either a thesis or nonthesis option under the department Master of Arts degree program The thesis option requires a minimum of 30 graduate credit hours and the completion of a thesis The nonthesis option requires a minimum of 34 credit hours and the development of a research project, or an exhibition In either option a minimum of 6 credit hours of related course work is required outside of the department Specific information about the requirements for either of the degree options is available from the departmental office

The department also cooperates in the interdepartmental minor program of Housing (see *Index*)

Open to graduate students for minor only 433, 450, 469, 471

Courses Primarily for Undergraduate Students

101 Foundations of Design (2-0) Cr 2 F S Understanding the creative design process through an exploration of the art elements, contemporary design, and interdisciplinary relationships to art and design

102 Basic Design Studio (0-4) Cr 2 F S Two- and three-dimensional design experiences Fee

170 Calligraphy (1-5) Cr 3 F S SS Handwritten letter forms derived from traditional alphabets Exploration of tools, materials, and composition Fee

203 Color (1-5) Cr 3 F S *Prereq 102 or Dsn S 140* Experiences in color interaction, color theory and the understanding of additive and subtractive color mixture

204 Three-Dimensional Studio. (Arch 204) (0-6) Cr 2 each time taken F S Investigation of basic sculptural media modeling in clay, wood carving, stone carving casting in plaster and metal, welding, and other constructing techniques No more than a sum of 8 credits may be applied toward a degree in the art and design department

205 Space, Light, and Shadow. (1-5) Cr 3 S *Prereq 102 or Dsn S 140* Introduction to space interpretation Natural and artificial light modulation Fee

212 Introduction to Art Education. (2-3) Cr 3 F S SS Introduction to the field of art education Coordinated lecture and studio experience Fee

213 Practicum: Art Education. (0-2) Cr 1 each time taken, maximum of 3 F S *Prereq Credit or classification in 212* Field experience in art education programs

220 Design in Wood (1-5) Cr 3 F S Introduction to the visual and aesthetic qualities of wood, woodworking techniques Fee

222. Design in Clay (1-5) Cr 3 F S SS Introduction to clay construction, decoration, and firing Fee

227 Jewelry and Decorative Metalsmithing (1-5) Cr 3 F S Design of jewelry and metal objects using basic construction techniques Fee

233 Painting. (1-5) Cr 3 F S SS *Prereq Dsn S 140* Introduction to water based media Fee

235. Drawing I (1-5) Cr 3 F S.SS *Prereq Dsn S 140* Emphasis on composition and techniques in relation to visual imagery Fee

236. Drawing II. (Arch 236) (0-6) Cr 2 F S *Prereq Arch 235 or Art 235* Freehand drawing as a design tool conceptualization, development, refinement, and presentation Includes the human figure in relation to architectural space, and scale Fee

243. Fiber Preparation and Structural Fabric Design. (1-8) Cr 3 F S Use of natural fibers and dyes, spinning and fabric construction using off-loom processes Fee

244. Design in Structural Fibers. (1-8) Cr 3 F S Fabric design on a four-harness loom

247 Stitchery and Fabric Assemblage. (1-5) Cr 3 F S Two- and three-dimensional design problems using stitchery techniques Fee

261. Fundamentals of Interior Design. (2-3) Cr 3 F S SS Use of design principles, color and materials for creating a life space Lecture and studio experiences introducing the field of interior design Fee

264. Interior Delineation. (1-5) Cr 3 F S *Prereq 203, credit or classification in 261, Fr E 125* Principles of freehand and mechanical perspective as applied to interior illustration, varied media and techniques for presentation drawings Fee

270. Graphic Lettering and Typography (1-5) Cr 3 F S *Prereq 170, Dsn S 140* Transition from hand drawn letter forms to typography Introduction to type specifications, letter design, and designing with type Field trip Fee

278. Fashion Illustration I. (TC 278) (1-5) Cr 3 F S *Prereq Dsn S 140* Drawing the fashion figure and apparel from live models Studies and compositions in a variety of media Historical survey Fee

279 Fashion Illustration II. (TC 279) (1-5) Cr 3 S *Prereq 278* Fashion figure and apparel drawing from live models with an emphasis on watercolor and other media The fashion figure in advertising or fashion design presentation plates Fee

280. History of Art I (3-0) Cr 3 F S Development of the visual arts of western civilization including painting, sculpture, architecture, and crafts from prehistoric through Gothic

281 History of Art II (3-0) Cr 3 F S Development of the visual arts of western civilization including painting sculpture, architecture, and crafts from the Renaissance to the twentieth century

295. History of Furniture and Ornament I (3-0) Cr 3 F Furniture styles, interior architectural backgrounds and ornamental arts of Europe

296 History of Furniture and Ornament II. (3-0) Cr 3 S Furniture styles, interior architectural backgrounds and ornamental arts of America

300 Sources of Visual Design (1-5) Cr 3 F *Prereq Dsn S 140* Discussion and studio exercises to develop awareness of external and internal sources for design Fee

301 Design Workshop (0-4 to 0-10) Cr 2 to 5 each time taken, maximum of 10 F *Prereq Dsn S 140* Problems in two- and three-dimensional design group and individual problems, class critiques Fee

312 Perceptual Education Methods. (2-4) Cr 3 S *Prereq 212, application to the teacher education program through art education* Theories of perceptual growth and their implications for art education Developing techniques for promoting visual thinking skills Fee

320 Design in Wood (1-5) Cr 3 each time taken, maximum of 9 S *Prereq 220* Design and construction techniques for case goods Fee

322 Design in Clay (1-5) Cr 3 F *Prereq 222, M S E 380* Wheel throwing, hand building, kiln stacking and firing Fee

327 Jewelry and Decorative Metalsmithing. (1-5) Cr 3 each time taken, maximum of 6 F *Prereq 227* Design of jewelry and hollow forms combining traditional construction and casting techniques Fee

332 Two-Dimensional Studio (Arch 332) (0-6) Cr 2 each time taken F S Investigations in visual design through the medium of studio painting Emphasis on materials, techniques, and color/shape relationships, with consideration for their expressive, decorative, and optical potentials No more than a sum of 8 credits may be applied toward a degree in the art and design department

333 Painting (1-5) Cr 3 F S *Prereq 235* Oil and/or acrylic media Fee

346. Resist and Dyed Fabric Design. (1-5) Cr 3 F S Batik and tie-dye applied to two- and three-dimensional fabrics Fee

347 Printed Fabric Design. (1-5) Cr 3 F S Repeat pattern design using block and screen printing techniques Fee

350 Life Drawing. (1-5) Cr 3 each time taken, maximum of 9 F S *Prereq Dsn S 140* Drawing from the human figure Fee

358. Printmaking: Lithography (1-5) Cr 3 each time taken, maximum of 9 F S *Prereq 235* The planographic process theory and practice Principles and characteristics of metal plate lithography, studio production Fee

359. Printmaking: Intaglio. (1-5) Cr 3 each time taken, maximum of 9 F S *Prereq 235* Studio exploration of intaglio processes to develop basic knowledge and production skills with limited edition prints Fee

363. Interior Materials and Systems. (3-0) Cr 3 F *Prereq 261, TC 204* Technical knowledge of interior furnishings, products, and materials construction elements and mechanical systems

364 Residential Interior Design I. (1-5) Cr 3 F S. *Prereq 264, credit or classification in 296 and F E 308.* Design problems for the multi-unit residential environment Design concept, space planning, furniture, accessory, and materials selection, color schemes, visual presentation Fee

367 Commercial Interior Design I. (1-5) Cr 3 F S *Prereq 364* Design problems include restaurant, retail store, and office planning Design concept, space planning, furniture, accessory, and materials selection, color schemes, and visual presentation Field trip Fee

368 Contemporary Interior Design Concerns. (2-2) Cr 3 S *Prereq 363* Contemporary designers and design trends, including interiors, furnishings, and product design Field trip Fee

369 Interior Design Internship Arr Cr 6 SS *Prereq 363, 364 367* Professional interior design off-campus experience, with an emphasis in market research, business procedures, and client relationships

370 Graphic Design I (1-5) Cr 3 F S.SS *Prereq 270, Fr E 125* Body copy, display copy and photo indication for layout Layout design for television and print media Field trip Fee

375. Graphic Art Production Methods (1-5) Cr 3 F S *Prereq 370* Design and preparation of camera ready art, type specification Field trip Fee

383 Greek and Roman Art. (3-0) Cr 3 Alt S, offered 1983 Greek art from Neolithic and Hellenistic periods Roman art from the traditional founding to the end of the empire in the West

385 Renaissance Art. (3-0) Cr 3 Alt S, offered 1982 European art including painting, sculpture, architecture, and crafts, thirteenth through sixteenth centuries

386. Baroque and Rococo Art. (3-0) Cr 3 Alt F, offered 1982 European art including painting, sculpture, architecture, and crafts, seventeenth and eighteenth centuries

389 Twentieth Century American Art. (3-0) Cr 3 S American art from 1900 to the present

391 Twentieth Century European Art. (3-0) Cr 3 Alt F offered 1981 Painting, sculpture, architecture, and crafts of Europe, 1900 to the present

415 Strategy and Curriculum Design. (3-3) Cr 3 F S *Prereq 312, admission to teacher education program through art education* Organizing art experiences for the classroom Field experience Taught in 4-week session preceding student teaching experience Fee

417, 418 Supervised Teaching of Art. (12 weeks) Cr 6 each F S *Prereq All courses in art and education in the art education curriculum, advance reservation required* Experience in teaching art 417 in the elementary school, 418 in the secondary school Taught in conjunction with 415

420 Design in Wood (1-5) Cr 3 each time taken, maximum of 9 F *Prereq 220* Frame construction design and techniques Fee

422 Design in Clay. (1-5) Cr 3 each time taken, maximum of 9 S *Prereq 322, M S E 381* Experimentation with clays, glazes, firing techniques, and raku Fee

427 Jewelry and Decorative Metalsmithing. (1-5) Cr 3 each time taken, maximum of 6 S *Prereq 227* Design of jewelry and hollow forms using advanced construction techniques

433 Advanced Painting. (1-5) Cr 3 each time taken, maximum of 9 F S *Prereq 333* Figurative and/or non-figurative painting with extended work in media and composition Fee

444. Design in Structural Fibers. (1-8) Cr 3 each time taken, maximum of 6 F S. *Prereq 244* Two- and three-dimensional weaving

447. Surface Design — Advanced Fabric Design. (1-5) Cr 3 each time taken, maximum of 6 S *Prereq. 6 credits in surface design* Dyeing, printing, stitching, and mixed media, two- and three-dimensional development Fee

450. Advanced Drawing. (1-5) Cr 3 each time taken, maximum of 9 F S. *Prereq 235* Figurative and/or non-figurative drawing with extended work in media, composition, and theory Fee

463. Interior Space Analysis and Planning. (2-2) Cr 3 F *Prereq: 367.* Interior program analysis, space planning, evaluation and computer simulation. Field trip Fee

465. Residential Interior Design II. (1-5) Cr 3 F S *Prereq 369, credit or classification in F E 412* Research and design problems for the single family detached dwelling Fee

469. Commercial Interior Design II. (2-6) Cr 4 F S *Prereq 369, credit or classification in 463* Research and design problems relating to specialized institutional environments and complex multi-unit planning Professional ethics, general business procedures, and written specifications Fee

470. Graphic Design II. (1-5) Cr 3 F S *Prereq. 370* Design concept from rough through comprehensive stages for television and publication. Field trip Fee

471. Graphic Illustration. (1-5) Cr 3 F S *Prereq 370* Exercises with varied techniques in both black and white and color Fee

490. Independent Study. Cr 2 to 6 each time taken *Prereq: Permission of instructor*
A Drawing
B Painting
C Art Education
D Art History
E Interior Design
F Graphic Design
G Fashion Illustration
H Honors
I Clay (Fee)
J Wood (Fee)
K Metal (Fee)
L Fiber (Fee)
M Printmaking (Fee)
N Design

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

550 Advanced Drawing. (1-5) Cr 3 each time taken, maximum of 9 F S *Prereq 12 credits of undergraduate drawing* Figurative and/or non-figurative drawing with extended work in media, composition, and theory Fee

590 Special Topics. Cr arr F S SS *Prereq Bachelor's degree in art and/or design, or evidence of satisfactory equivalency in specialized area*
A Drawing
B Painting
C Art Education
D Art History
E Interior Design
F Graphic Design
I Clay
J Wood
K Metal
L Fiber
M Printmaking
N Design

Courses for Graduate Students, major or minor

605. Seminar Cr 2 F S

699. Research Cr var F S SS

Astronomy and Astrophysics

For description of courses, see *Physics*

Bacteriology

See *Microbiology*

Biochemistry and Biophysics

James Allen Olson, Chair of Department

Professors: Applequist, Atherly, Beitz, Bremner, French, Fromm, Graves, Hammond, Horowitz, Metzler, Olson, Robson, Stone, Stromer, B H Thomas, Tipton, Warner, Young

Associate Professors: D Balinsky, Foss, Gaessler, Outka, Rebers, Robyt, Rougvie, J A Thomas, White

Assistant Professors: Cox, Jackman

Undergraduate Study

The department offers majors in biochemistry or biophysics for students in the College of Sciences and Humanities and a major in agricultural biochemistry for students in the College of Agriculture

Biochemists and biophysicists seek to understand life processes in terms of chemical and physical principles. They are employed wherever a better understanding of living organisms is sought, whether it be in the production of antibiotics or vitamins in a fermentation industry, in investigation of nutritional requirements of plants or animals, or in the study of the functions of the human body in health and disease There are many opportunities in universities and medical schools, government laboratories, and industry for men and women well trained in biochemistry or biophysics Students who meet the necessary high scholastic standards usually continue their studies in a graduate college

Agricultural Biochemistry Major in the College of Agriculture

For the undergraduate curriculum leading to the degree Bachelor of Science, see *College of Agriculture, Curricula* This program of study is recommended to students interested in advanced study or employment in areas of agriculture requiring strong preparation in biochemistry, chemistry, physics, and mathematics, or in preparation for the study of veterinary medicine

Biochemistry or Biophysics Majors in the College of Sciences and Humanities

For the undergraduate curriculum leading to the degree Bachelor of Science, see *Sciences and Humanities, Curriculum*. These programs are recommended to students whose career interests might involve advanced study or employment in biochemistry or biophysics, or in related areas of the biological or medical sciences

Undergraduate sciences and humanities majors in biochemistry usually have the following basic courses or their equivalents in their programs B B 101, 102, 201, 411, 461 or 551, 501, 502, (or 404, 405), Chem 177, 177L, 178, 210, 331, 332, 333A or B, 334A or B, 324, 325, 325L; Math 165, 166, 266, Phys 221, 222, Biol 110, 110L and a minimum of 10 credits of biological science courses from Biology, Botany, Genetics, Microbiology, and Zoology

Undergraduate majors in biophysics usually include the following basic courses in their programs. B B 101, 461 or 551, Chem 177, 177L, 178, 210, 321, 321L (or Phys 311), 322, 331, 332, Math 165, 166, 265, 266, and 125 or Com S 172, Phys 221, 222, 324, Biol 110, 110L, Zool 206 or Bot 207, Gen 330; and 6 additional credits in advanced biochemistry, biophysics, biological sciences, chemistry, or physics Students wishing a strong preparation for graduate studies are advised to take further mathematics courses such as 385 and 465

These lists of courses should not be regarded as statements of fixed requirements or as complete outlines of the work necessary for the major They are given solely for the convenience of students or advisers who wish to estimate the amount of basic study that may be needed

Sciences and humanities majors are required to earn 8 credits in a foreign language, preferably French, German, or Russian.

For courses in agricultural biochemistry, see biochemistry curriculum under College of Agriculture listing

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with majors in biochemistry, biophysics, and molecular, cellular, and developmental biology, and minor work to students taking major work in other departments

The department also participates in the interdepartmental programs in Immunobiology, and Molecular, Cellular, and Developmental Biology (See Index)

Prerequisite to graduate work is completion of sufficient undergraduate work in chemistry, mathematics, physics, and biology

All graduate students are required by the department to teach as part of their training for an advanced degree

Candidates for the degree doctor of philosophy must demonstrate a reading knowledge of one foreign language, preferably French, German, or Russian, either by passing (50th percentile or better) the Educational Testing Service examination or obtaining a grade of C or better in a one-year college course in a foreign language A foreign student whose native language is Chinese, French, German, Italian, Japanese, Russian, or Spanish may be excused from the foreign language requirement

Open to graduate students for minor credit only 404, 405, 411, 420, 451, 461

Courses Primarily for Undergraduates

101. Introduction to Biochemical Activities. (1-0) Cr 1 F Research activities, career opportunities in biochemistry and biophysics, and an introduction to structural aspects of biochemistry

102. Introduction to Biochemistry (1-0) Cr 1 S *Prereq 1 semester of chemistry* Fundamentals of biochemistry including biopolymers, biocatalysis, metabolism, and biochemical experiments For majors and potential majors in biochemistry and biophysics

***201 The Chemistry of Life.** (2-0) Cr 2 S. *Prereq Chem 331* Chemical basis of selected aspects of enzymology, metabolism, and molecular biology For sophomore majors in biochemistry and biophysics, open to others desiring a sophisticated introduction to biochemistry

†*221. Structure and Reactions in Biochemical Processes. (3-0) Cr 3 F.S. *Prereq 1 semester of chemistry.* Fundamentals necessary for an understanding of biochemical processes. For students in agriculture. Not acceptable for credit toward a major in biochemistry or biophysics

†*301. Survey of Biochemistry. (3-0) Cr 3. F S SS. *Prereq. Chem 231 or 331.* A survey of the chemistry of biological molecules, enzymology, metabolism, biosynthesis, and selected topics. Not accepted for credit toward a biochemistry or biophysics major

†311 **Biochemistry Laboratory** (1-3) Cr 2. F S SS *Prereq Credit or classification in 301* Emphasis on isolation, characterization, and quantification of biological substances Not acceptable for credit toward a major in biochemistry or biophysics

†*404, †*405. **Biochemistry.** (3-0) Cr 3 each Yr *Prereq 404 Chem 332, 405 404* A fundamental rigorous treatment for graduate and advanced undergraduate students in agricultural, biological, and nutritional sciences 404 Chemistry of amino acids, proteins, carbohydrates, lipids, vitamins, and nucleotides, enzymology, metabolism of carbohydrates and lipids 405 Metabolism of amino acids and nucleotides, biosynthesis of membranes, DNA, RNA, and proteins, genetic code, metabolic regulation, comparative biochemistry, and selected topics

411 **General Biochemical Research Techniques.** (1-6) Cr 3 F *Prereq 201 or 404 or 501, Chem 210 or 211* Introduction to techniques for studying biochemistry, including paper, gas, and column chromatography, enzyme isolation and kinetics, use of radioisotope tracers

*420 **Physiological Chemistry.** (4-0) Cr 4 F *Prereq 301 and Chem 332* Structure and function of proteins, enzymology, biological oxidation, chemistry and metabolism of carbohydrates, lipids, amino acids and nucleic acids, protein synthesis and the genetic code, relationship of biochemistry to selected animal diseases Biochemistry of higher animals will be emphasized Not acceptable for credit toward a major in biochemistry or biophysics

451 **Introduction to Physical Biochemistry.** (2-0) Cr 2 S *Prereq Chem 331, Phys 112 or 222, a previous course in calculus is helpful but not required* Selected topics in physical chemistry in the context of applications to problems in biology, biochemistry and food sciences Not acceptable for credit toward a major in biochemistry or biophysics

461 **Introduction to Biophysics.** (2-0) Cr 2 F *Prereq 451 or Chem 321 or 324 or Phys 304* Biological phenomena viewed as problems in physics Survey of selected topics such as bioenergetics, muscle contraction, nerve conduction, vision, and macromolecular behavior

490 **Independent Study.** F S SS Cr arr

499 **Undergraduate Research.** F S SS. Cr 1-5 each time taken *Prereq Permission of staff member with whom student proposes to work* Research under senior staff guidance

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

501, 502. **General Biochemistry.** (4-0) Cr 4 each Yr *Prereq 501 Chem 210 or 211, 332, and 322 or 325, 502 501* Chemical composition of living matter and the chemistry of life processes 501 Chemical characterization of amino acids, proteins, carbohydrates, lipids, and nucleotides, membranes, enzymology and co-enzymes, metabolism of carbohydrates and lipids, biological oxidations 502 Metabolism of amino acids and nucleotides, biosynthesis of DNA, RNA, and proteins, genetic code, hormones and metabolic regulation, molecular immunology; muscle biochemistry For graduate students in biochemistry and biophysics, advanced undergraduates in biochemistry or chemistry, and qualified students desiring a rigorous course

511 **Topics in Experimental Biochemistry** Cr var 1-3 S *Prereq 404 or 501 and Chem 210 or 211* Use of selected techniques to examine biological macromolecules, physical-chemical characterization of proteins and nucleic acids, enzymology, molecular biology Taught as individual one-credit modules

521. **Radiobiochemistry.** (2-6) Cr 2 S 8 weeks *Prereq 404 or 501 and Chem 210 or 211* A laboratory course in biochemical uses of radioisotopes Basic counting techniques, liquid scintillation counting, isotope dilution techniques, radio-autography, radioimmunoassay, and elucidation of reaction mechanisms using labeled compounds

†526. **Cell Biology of Selected Eukaryotic Cell Systems.** (2-0) Cr 2 F Outka. *Prereq. 405 or 502, Zool 428 or 325, or Bot 444* Primitive motile systems and their assembly microtubules and filaments, cilia, flagella, pseudopodia, cell membrane elaborations, extracellular matrices, cell walls Cytoplasmic inheritance centrioles, basal bodies, mitochondria, plastids Somatic cell hybridization mouse-human hybrids, plant cell hybrids, totipotency, C-4 photosynthesis, nitrogen fixation

551. **Molecular Biophysics.** (3-0) Cr 3 F *Prereq Math 166, permission of instructors* Foss, Rougvie An examination of physical methods for the study of the molecular structure and organization of biological materials, with emphasis on applications Spectroscopy, hydrodynamic methods, and X-ray diffraction

574. **Microscopy** (2-0) Cr 2 S *Prereq Permission of instructor* Outka Principles, methods, and applications of light and electron microscopy Light optics including phase contrast, fluorescence, and polarization High resolution electron optics Specimen preparation Photography

575 **Laboratory in Microscopy** (0-6) Cr 2 S *Prereq Credit or classification in 574* Outka Practical experience in microscopy Designed to be taken concurrently with 574

581 **Seminar** (1-0) Cr 1 F *Prereq Permission of instructor* Short talks and discussion by students on assigned topics For entering graduate students and qualified seniors

590. **Special Topics.** F S SS Cr arr

591 **Optical Instrumentation Laboratory** Cr 1 SS *Prereq Permission of instructor* Foss Training in the operation of spectrophotometers, spectrophotofluorimeter, and dichrograph A concentrated one week course for students planning research use of this instrumentation

592 **Analytical Ultracentrifugation Laboratory.** Cr 1 SS *Prereq Permission of instructor* Rougvie Training in the operation of the analytical ultracentrifuge A concentrated one week course for students planning research use of this instrument

Courses for Graduate Students, major or minor

615 **Molecular Immunology** (Micro 615) (2-0) Cr 2 F Warner *Prereq 405 or 502* Contemporary topics in immunochemistry, immunobiology, and immunogenetics

†622 **Carbohydrate Chemistry** (2-0) Cr 2 Alt SS, offered 1982 French, Robyt *Prereq 404 or 501* Chemistry and biochemistry of simple and complex carbohydrates

630 **Lipids.** (2-0) Cr 2 Alt SS, offered 1983 Tipton *Prereq 405 or 502* The metabolism of complex lipids and the role of lipids in the structure and function of biological membranes

632. **Kinetics of Enzyme Action** (2-0) Cr 2 Alt F, offered 1982 Fromm *Prereq 501* Topics covered will include enzyme-substrate interaction, inhibition, functional groups involved in catalysis, isotope exchange, allostery, integrated rate equations and pre-steady state kinetics

642. **Mechanism of Action of Enzymes and Coenzymes.** (2-0) Cr 2 Alt F, offered 1981 Metzler *Prereq 404, 420, or 501* Chemical mechanisms of enzymatic catalysis, chemistry of vitamins, coenzymes, prosthetic groups, and metal-containing centers of enzymes

645. **Biochemistry of Metabolic Regulation.** (3-0) Cr 3 Alt F, offered 1981 Beitz, Thomas *Prereq Credit or classification in 420, 405, or 502* Advanced topics in regulation of metabolism with emphasis on important regulatory molecules, and mechanisms of enzyme regulation The second half of the course will deal extensively with molecular mechanisms of selected hormone action

650 **Biochemical Thermodynamics.** (2-0) Cr 2 Alt. S, offered 1982 Applequist *Prereq. Chem 321 or 324* Biochemical phenomena such as metabolism, coupled reactions, denaturation of macromolecules, cooperativity, and membrane phenomena studied in the framework of thermodynamic principles

652. **Protein Chemistry** (2-0) Cr 2 Alt S, offered 1983 Graves, Robyt, *Prereq 404 or 501* Chemical reactions and physical changes of proteins as a means of determining their structures and biological functions

†670. **Molecular Biology of Muscle.** (An S 670) (3-0) Cr 3 Alt F, offered 1982 Robson, Stromer *Prereq. 405, 420, or 502* Microstructure and chemical composition of muscle tissue Chemistry, function, and turnover of muscle and connective tissue protein Molecular aspects of muscle contraction

675. **Nucleic Acids and Gene Regulation.** (3-0) Cr 3 Alt S, offered 1982 Cox, Horowitz *Prereq. 405 or 502* Properties of nucleic acids and nucleoproteins Relationship of nucleic acid structure to function Chromatin structure and gene activity Mechanisms of transcriptional and translational control Oncogenesis

681 **Advanced Seminar.** Cr 1 F S *Prereq Permission of instructor* Student presentations

682. **Departmental Seminar.** Cr R F S *Prereq Permission of instructor* Staff and visitor presentations

698. **Seminar in Molecular, Cellular, and Developmental Biology.** (MCDB 698) See *Molecular, Cellular and Developmental Biology*

699. **Research.** *Prereq Permission of instructor*

***Credit for both 420 and 404, 405 (501, 502), for both 201 and 301, or for both 221 and Chem 231 may not be applied toward graduation.**

†Administered by the College of Agriculture. Courses not marked are administered by the College of Sciences and Humanities.

Biology

Warren D Dolphin, Program Executive Officer
Robert Chapman, Convener, Faculty Committee

Biology as a discipline encompasses a number of departments at Iowa State University. Basic undergraduate and graduate courses are offered in the departments of animal ecology, biochemistry and biophysics, botany, genetics, microbiology, and zoology In addition, several departments in the colleges of Agriculture, Home Economics, and Veterinary Medicine provide undergraduate and graduate programs in applied and specialized phases of the biological sciences.

A student who prefers a rigorous but broad course of studies in the life sciences may declare a biology major at the undergraduate level leading to the degree bachelor of science General biology training is particularly suited for those who plan to teach biology, enter government or industrial employment in health or environment related professions, or who desire educational breadth as an end in itself Biology provides a broad background for advanced study in a particular biological discipline

Biology can be usefully joined with other fields of specialization, e g majors in biology and environmental studies may be linked, students envisaging political or legal careers may combine biology courses with offerings in political science, economics or social science; those interested in science journalism might desire to link journalism and biology, those wishing to study biological illustration may take courses in both biology and art. Other combinations may be pursued and double majors are encouraged

Undergraduate Study

Biology 109 is a general survey of biology designed primarily for students who expect to take no further courses in the biological sciences Biology 110 is the basic beginning course for students majoring in the life sciences. Non-major students, anticipating taking one or more advanced courses in the biological sciences, are advised to enroll in Biology 110 rather than Biology 109 because it is the usual departmental prerequisite for advanced life science courses.

Biology majors take the following courses: Biol 100, 110, 110L, 303, 312, Zool 206, 206L, Bot 207, Micro 300, Gen 320 or 330, B B 301 or 404, 405, plus at least 12 additional credits in approved life-science courses numbered 300 or above and selected from more than one

department. Advanced students are encouraged to enroll in Biol 490 (Independent Study) and 495 (Seminar).

Supporting courses include two semesters of general chemistry, one or two semesters of organic chemistry, two semesters of general physics, and two semesters of applied or theoretical mathematics beyond the level of algebra and trigonometry. (A list of appropriate courses is available in the Biology Office)

Credits for one year of a foreign language are required, except that the language requirement may be waived for students with two or more years of credit with an average of B or above in one language from high school Students must earn a minimum grade of C in both English 104 and 105 or equivalent composition courses

Beyond the required courses listed, the student may choose others that amplify breadth or provide specialization congruent with specific interests See listings of the several life science departments. In addition to courses offered on campus, courses in field and aquatic biology are offered at the Iowa Lakeside Laboratory Courses in marine biology are available at the Gulf Coast Research Laboratory in Mississippi See departmental entries for descriptions of these courses

Biology majors seeking certification to teach biology in secondary schools must meet requirements of the College of Education as well as those of the biology program In addition they must apply formally for admission to the teacher education program See Index, *Teacher Certification*

Advisers in the biology program are faculty members from the participating departments

Graduate Study

Persons interested in graduate study in biology may take the Master of Science or Doctor of Philosophy degree with a major in any of the life science disciplines Interdepartmental graduate programs in Molecular, Cellular, and Developmental Biology (MCDB), General Graduate Studies, Immunobiology, Biomedical Engineering, and Water Resources are also available

The master's degree in General Graduate Studies (Biological Sciences) has been established particularly for teachers who wish to broaden and update their formal training in biology.

Courses Primarily for Undergraduate Students

100. Opportunities in Biology (2-0) Cr R F First 8 weeks Introduction to the scope of biological science, areas of study, and professional opportunities Required of first year biology majors

***109. Introductory Biology.** (3-0) Cr 3 F S SS Life considered at cellular, organism and population levels Function and diversity of the living world Basic biological principles and their relevance to modern civilization Non-majors only

***110. Principles of Biology.** (3-0) Cr 3 F S *Prereq Credit or classification in 110L and Chem 163 or 177 recommended* Organization, metabolism and reproduction of living systems at the molecular, cellular and population levels. Includes growth, development, reproduction, inheritance, evolution, ecosystems, populations. For majors and others intending to take advanced courses in the life sciences.

110L. Laboratory in General Biology. (0-3) Cr 1 F S *Prereq: Credit or classification in 110; concurrent classification recommended.*

303. Biological Evolution. (Zool 303) (3-0) Cr 3 S.SS. *Prereq. credit or classification in Bot 207 or Zool 206 and a course in genetics* Origin, unity and diversity of organisms, sources and interpretation of evidence, natural selection, analysis of genetic mechanisms of evolution

312. Ecology. (A Ecl 312) (2-3) Cr 3 F SS *Prereq Bot 207 or Zool 206* Fundamental concepts and principles of ecology dealing with ecosystems, communities and populations Field trips include studying habitats and environmental problems

490. Independent Study. Cr 1-5 each time taken *Prereq Permission of instructor* See also 490 offerings in biological science departments

495. Undergraduate seminar. Cr 1 each time taken F *Prereq 15 cr in biological science*

Courses Primarily for Graduate Students for minor credit, open to qualified undergraduates

500 History of Biology (3-0) Cr 3 S *Prereq 12 credits in biological science, history majors 6 credits in biological science* Biological discovery and its relationship to the cultural setting, influence of biology on social change

*Credit for both 109 and 110 may not be applied toward graduation

Biomedical Engineering

(Interdepartmental Program)

Neal R Cholvin, Professor in Charge

Professors: Brockman, R Carithers, Cholvin, Engen, R Greer, Rogge, Seagrave, Swift, Young

Associate Professors: Carlson, M H Greer

The Biomedical Engineering (BME) Program is interdisciplinary in scope and is sponsored jointly by the colleges of Engineering and Veterinary Medicine Biomedical engineers are concerned with the application of engineering concepts and analytical techniques to biological and medical problems They are interested in developing new concepts and instrumentation for measurements of living systems In addition, they seek to understand those phenomena of living systems which have functional capabilities desirable in the design of physical systems Following completion of biomedical engineering training, they engage in research careers in the various fields of biomedicine and engineering, and in the environmental sciences. They may work on multidisciplinary teams in industrial, governmental, or academic research institutes Individuals with this training can correlate and adapt engineering principles to the problems of medicine and biology, by utilizing engineering knowledge to increase understanding of the functions of biological systems, and by developing new quantitative methods for scientific investigation, and for diagnosis and therapy

Undergraduate Study

A curriculum leading to a bachelor's degree in biomedical engineering is not offered Undergraduate students planning graduate study are encouraged to develop knowledge in subjects prerequisite to biomedical engineering courses For example, undergraduate students majoring in engineering, physics, or mathematics are encouraged to elect courses in organic chemistry, biochemistry, and biology Undergraduate students majoring in life science areas should prepare for graduate study by electing courses in mathematics, engineering, and physics

Graduate Study

Work is offered for the degrees Master of Science and Doctor of Philosophy with major in biomedical engineering, and minor work for students taking major work in other areas Prerequisite to major and minor work in the interdepartmental program of biomedical engineering is an undergraduate degree in one of the fields of engineering, life sciences, physical sciences, or a professional degree in one of the fields of medicine

Depending upon the individual's background, the BME major will usually elect minor work in one of the following curricula. biochemistry and biophysics, chemical engineering, computer science, electrical engineering, engineering mechanics, mathematics, mechanical engineering, psychology, veterinary anatomy veterinary clinical sciences, veterinary pathology, veterinary physiology, or zoology All students are encouraged to obtain previous background knowledge of organic chemistry, calculus, beginning differential equations, and physics

The program of formal courses taken by students is oriented toward developing proficiency in research in the interdisciplinary field or in utilizing biomedical principles in clinical situations Selected background and advanced courses from related disciplines are taken in conjunction with appropriate biomedical engineering courses

The program of formal courses varies, depending upon the background and interests of the student, and is determined in consultation with the student's committee

Courses Primarily for Undergraduate Students

401 Introduction to Biomedical Engineering. (3-0) Cr 3 S *Prereq: Junior classification* An introduction to biomedical engineering principles, including biomedical applications of basic electronics, measurement techniques, transducers, transport phenomena, mechanics, and computer simulation Not acceptable for major or minor credit in biomedical engineering

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

520. Biomechanics. (E M 520) (3-0) Cr 3 S *Prereq Phys 111 or 221, Math 265* For students with interests in the life sciences who wish to obtain background in applied mechanics. Topics include equilibrium, vibratory motion, stress and deformation, material properties, flow of fluids, dimensional analysis and modeling of biological systems. Illustrative examples taken from biology and medicine

525. Anatomy and Physiology for Biomedical Engineers (2-1) Cr 3 F *Prereq Phys 221* Microscopic and gross anatomy with emphasis on functional relationships and engineering design

530. Biothermodynamics and Transport Phenomena. (3-0) Cr 3 S *Prereq Math 176 or 266, Phys 222* The principles of thermodynamics and transport phenomena applied to the study of physiology and the design and operation of artificial organs and life support systems

551, 552. Advanced Vertebrate Physiology. (V P P 551 552, Zool 551, 552) See Zoology

555. Biomedical Fluid Mechanics. (E M 555) (3-0) Cr 3 S *Prereq: 520* Application of principles and concepts of fluid mechanics to problems in biology and medicine Hemodynamic characteristics of the circulation, rheology of blood, flow in the microcirculation, flow in the large arteries, and the respiratory system

560. Clinical Engineering. (3-0) Cr 3 S *Prereq E E 441* Principles of electronic monitoring in health care facilities, physiologic effects of electric current, electric shock hazards, power distribution systems consideration Application of solid-state devices for

analog signal measurement and processing, digital signal processing

565 **Electrophysiology.** (2-0) Cr 2 S *Prereq 551, Math 176, Phys 222* Electrical events in living systems Mathematical and electrical models for resting and action potentials in nerves and for transmission between cells

570 **Biomedical Instrumentation.** (3-0) Cr 3 S *Prereq E E 441* Characteristics of biological signals, transducers, error and artifact suppression, biological data acquisition and processing systems

575 **Simulation of Biological Systems.** (3-0) Cr 3 F *Prereq 525, 530* Development of mathematical models for living systems, including control systems, population dynamics, cardiovascular and respiratory systems, and anesthesia delivery systems

580 **Biomaterials** (E M 580, M S E 580) (3-0) Cr 3 S *Prereq M S E 270, permission of instructor* Presentation of the basic chemical and physical properties of biomaterials as they are related to their manipulation by the engineer for incorporation into living systems Role of microstructure properties in the choice of biomaterials and design of artificial organs, implants, and prostheses

585 **Information Processing in Living Systems.** (3-0) Cr 3 S *Prereq E E 441* Nervous and neuron network models, information processing in living systems, artificial intelligence, pattern recognition

590. **Special Topics.** Cr 1 to 5 as arranged Investigation of problems of special interest in biomedical engineering

595. **Biomedical Data Processing.** (2-0) Cr 2 F *Prereq E E 441* Digital data acquisition systems used in biomedical research, hardware, data reduction algorithms, digital filters

Courses for Graduate Students, major or minor

610 **Cardiovascular Transport and Control.** (2-0) Cr 2 S *Prereq 525, 530* Quantitative biophysics underlying the transport of material and energy in the cardiovascular system with special emphasis on control

615 **Experimental Surgery** (2-0) Cr 2 SS *Prereq 525* Advanced surgical procedures for quantitative studies in biomedical engineering

690 **Advanced Topics** Cr 1 to 5 as arranged
A Instrumentation
B Simulation
C Transport Phenomena
D Biomaterials
E Information Processing

699 **Research.**

Botany

Ronald C Coolbaugh, Chair of Department

Professors: Anderson, Coolbaugh, Dodd, Horner, Isely, Knaphus, LaMotte, Lersten, Nevins, Pohl, Smith, Stewart, Swenson, Tiffany

Associate Professors: Davis, Farrar, Glenn-Lewin, Outka, van der Valk

Assistant Professors: Chapman, Pearlmutter

Undergraduate Study

For undergraduate curriculum in sciences and humanities, major in botany, leading to the degree Bachelor of Science, see *Science and Humanities, Curriculum.*

The department offers broad study opportunity in many basic and applied aspects of plant biology Undergraduate programs are adapted to students of varied interests, preparing them for a wide range of science-related occupations, including biology teaching, conservation and outdoor recreation activities, and research, development, and sales programs of industry and agriculture The major offers excellent preparation for graduate study in botany, or in related disciplines such as agronomy, biology, forestry, horticulture, pest management, plant pathology, seed science, weed science, and water resources

Undergraduate programs usually include B B 301, Biol 110, 110L, 303, 312, Bot 207, 306, 320, 399, 404, 405, 406, 444, 484, Gen 330, Micro 300, 300L, PP SW 407, Zool 206, 206L, and a year of chemistry Qualified students are encouraged to enrich their program through an independent study or research project (Bot 490) under the guidance of a faculty member Supporting work in mathematical sciences and physics is strongly advised Courses at the Iowa Lakeside Laboratory, the Gulf Coast Research Laboratory, or other field laboratories are recommended

The courses listed above are not fixed requirements, but are intended as a guide to students and their advisers in planning a program best fitted to individual needs

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with a major in botany, and minor work for students majoring in other departments Within the botany major one of the following areas of specialization may be designated aquatic plant biology, cytology, ecology, economic botany, morphology, mycology, physiology, or taxonomy

The department also participates in the interdepartmental programs of Water Resources, and Molecular, Cellular, and Developmental Biology (See Index)

Prospective graduate students need a sound background in the physical, biological, and mathematical sciences, in English, and a reading proficiency in at least one foreign language The department requires submission of Graduate Record Examination aptitude test scores For the Ph D degree, reading proficiency in one foreign language is required This may be demonstrated by two years of course work, an ETS language examination, or a departmentally administered examination

Open to students for graduate minor credit 320, 403, 404, 405, 406, 424, 444, 484

Courses Primarily for Undergraduate Students

102. **Biology of Plants.** (2-4) Cr 2 F S SS 8 weeks Function, structure, development, and evolution of plants Primarily for students who do not plan to take Bot 207

202. **Field Botany** (2-4) Cr 2 F S SS 8 weeks. Field and laboratory studies of plants in various local habitats Includes trees, shrubs, flowering plants and other green plants, lichens and fungi Not recommended for students with professional interest in plant science

207 **General Botany** (2-3) Cr 3 F S SS *Prereq Credit or classification in Biol 110* Dodd Structure, function, and development, of leaves, stems, and roots Reproduction and evolutionary relationships of algae, fungi, bryophytes, lower vascular plants, and seed plants

256. **Dendrology** (For 256) (1-6) Cr 3 F *Prereq 207* Farrar Taxonomy, morphology, and ecology of North American species of woody plants of importance in timber production and wildlife food and cover Field trips

304. **Plants and Civilization.** (2-2) Cr 3. F *Prereq. Credit or classification in Biol 109 or 110 or Bot 102* Isely The role of plants in the origin, diffusion, and historical evolution of human cultures Plants and present needs food, industrial products, medicines Plants and the future food, energy, and the changing environment

306. **Plant Taxonomy.** (2-4) Cr 3 S SS *Prereq 207* Pohl Principles of classification of seed plants, survey of major plant families, identification and field study of local plants. Field trips

307. **Fundamentals of Botany.** (2-2) Cr 3 S *Prereq Chem 163 or 167* Study of plant structure and function, with emphasis on physiology of flowering plants

*310 **Plant Physiology.** (2-3) Cr 3 F SS *Prereq: 102 or 207, Chem 163L.* Stewart Basic physiological processes with emphasis on those processes which limit the production of food and other economically important plant products.

*320. **Plant Physiology.** (3-3) Cr 4 S *Prereq. 207, Chem 331 or B B 301* Nevins Application of physical and biological principles to the understanding of plant processes involved in assimilation, metabolism, and regulation of growth and development

399. **Undergraduate Seminar.** (1-0) Cr 1 each time taken S *Prereq. Junior classification and 8 credits in botany* Knaphus Meetings of students and staff to discuss topics of current interest in plant science

403 **Introductory Microtechnique.** (0-3) Cr 1 F SS *Prereq Classification in 404* Lersten Includes paraffin method, freehand sectioning, clearing technique, macerations

404. **Plant Anatomy.** (2-2) Cr 3 F SS *Prereq. 207, 306 recommended* Lersten Characteristics of cell and tissue types in vascular plants Anatomy of developing and mature stems, roots, and leaves

405. **Natural History of Plants.** (3-6) Cr 5 S *Prereq 207* Farrar, Lersten, Pearlmutter Evolutionary survey of algae, bryophytes, pteridophytes, gymnosperms, and angiosperms, including special aspects of ecology and physiology of non-flowering plants

406. **Principles of Mycology.** (2-3) Cr 3 F *Prereq 10 credits in biological sciences* Tiffany Morphology, taxonomy and ecology of fungi, their relation to agriculture and industry

424. **Nature and Management of Vegetation.** (2-3) Cr 3 F SS *Prereq A course in plant identification, Biol 312* Physical and biological factors controlling the composition and structure of natural plant communities Techniques for sampling, classifying, and managing prairie, forest, and wetland vegetation Collection and identification of common plant species Saturday field trips

444 **The Cell.** (3-0) Cr 3 F *Prereq 10 credits in biology including genetics, credit or classification in B B 301 recommended* The anatomy and physiology of cytoplasm The nucleus and its role in development and reproduction See 544 for accompanying laboratory

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***Credit for both 310 and 320 may not be applied toward graduation.**

484. **Plant Ecology** (3-0) Cr 3 S *Prereq Biol 312* Glenn-Lewin Principles of plant population, community, and ecosystem ecology

490 **Independent Study.** Cr 1 to 3 each time taken *Prereq 7 credits in botany, permission of instructor*
A Morphology
B Physiology
D Mycology
E Taxonomy
F Plant Ecology
H Honors
J Cytology
K Aquatic Plant Biology

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

500. **Field Biology of Freshwater Algae.** (2-3) Cr 3 F (SS Lakeside Lab) *Prereq 10 credits in biological sciences* Dodd Introduction to major groups of algae and their roles in freshwater habitats Environmental factors affecting growth and reproduction May be taken in summer at Iowa Lakeside Laboratory with written permission of instructor

501. **Marine Algae.** (2-0) Cr 1 Alt S , 8 weeks, offered 1982 *Prereq. 10 credits in biological sciences* Pearlmutter Morphology, ecology, and distribution of marine algae Emphasis on the macroalgae

502. **Cytology and Physiology of Algae.** (3-0) Cr 3 Alt F , offered 1982 *Prereq: 500, Chem 331 or B B 405* Pearlmutter Cell structure and function Factors affecting the metabolism, morphogenesis, and reproduction of the algae

511. **Plant Nutrition.** (2-0) Cr 2 F *Prereq: 320, Phys 111, Chem 331* Nevins Mineral nutrition, water relations, and translocation in vascular plants

512. Plant Growth Regulation. (3-0) Cr 3 S *Prereq 320, Phys 111 or 221, Chem 331* LaMotte Vascular plant growth, correlative phenomena in development, and hormones involved in their regulation.

513. Plant Metabolism. (2-0) Cr 2 S *Prereq 320, Phys 111, Chem 331* Stewart Photosynthesis, respiration, and other aspects of plant metabolism.

517. Physiological Methods and Techniques. (0-10) Cr 2 Alt. F., offered 1982 8 weeks *Prereq: Credit or classification in 511 or 512 or 513* Nevins Research methods and techniques in plant physiology

529. Fine Structure of Plant Cells. (3-0) Cr 3 Alt S., offered 1983 *Prereq: 310 or 320, 404* Structure and function of organs, tissues, cells, and cellular components at various levels of evolutionary development

544. Laboratory in Cytology. (0-3) Cr 1 F *Prereq A course in cell biology or classification in 444.* Optional laboratory to accompany 444 Light microscopic study of the nucleus and chromosomes

546. Ecology of Aquatic Fungi. (2-6) Cr 2 Alt S., offered 1982 8 weeks *Prereq 406* Aquatic fungi and their roles in fresh-water habitats Procedures for collection, culture, and identification

551. Lichens and Bryophytes. (2-4) Cr 2 Alt F, offered 1982 8 weeks *Prereq 10 credits in biological science* Tiffany, Lersten Morphology, classification, and natural history, collection and identification of specimens One weekend field trip

552. Pteridology (1-3) Cr 2 Alt SS, offered 1982 *Prereq 10 credits in biological sciences* Farrar Morphology, taxonomy, and ecology of the lower vascular plants, with emphasis on ferns

553. Sexual Reproduction in Flowering Plants. (2-0) Cr 2 Alt S, offered 1982 *Prereq 10 credits in biological sciences, including Bot 306* Lersten Development of reproductive structures, pollination, fertilization, embryo and seed development

558 Paleobotany. (2-4) Cr 2 Alt F, offered 1982 8 weeks *Prereq 10 credits in biological sciences* Farrar Introduction to morphology, identification, and phylogeny of fossil plants from Pre-Cambrian to present

559L. Field Biology of Bryophytes and Pteridophytes (See list of courses offered at *Iowa Lakeside Laboratory*)

564. Wetland Ecology (2-3) Cr 3 F *Prereq 10 credits in biological sciences* van der Valk Role of vascular plant communities in lakes, rivers, marshes and swamps Collection and identification of aquatic vascular plants Techniques for sampling and managing wetland vegetation Weekend field trips

575. Field Mycology (2-6) Cr 4 each time taken SS, offered 1983 (SS II 1982, Lakeside Lab) *Prereq 5 credits in botany* Tiffany Collection and identification of fungi and relation of their occurrence to environmental factors Preparation and utilization of mycological exsiccati May be taken at Iowa Lakeside Laboratory with written permission of instructor

584. Plant Communities and Ecosystems. (3-0) Cr 3 S *Prereq 424 or 484* Historical survey of approaches to the study of plant communities and ecosystems

585. Advanced Field Ecology. (0-6) Cr 2 each time taken F S *Prereq Graduate classification* Weekend and extended field trips to various vegetation types with emphasis on field problems Report required Fee charged

588. Plant Population Biology. (2-3) Cr 3 Alt S, offered 1983 *Prereq 10 credits in biological sciences* Chapman Theoretical and experimental approaches including models, natural selection, gene flow, genetic structure, speciation, hybridization, demography, population growth, and competition

590. Special Topics. Cr 1 to 3 each time taken *Prereq 10 credits in botany, permission of instructor*
A. Morphology
B Physiology
D Mycology
E Taxonomy
F Plant Ecology
G Economic Botany
J Cytology
K. Aquatic Plant Biology

595. Agrostology. (2-3) Cr 3 F *Prereq 306* Structure, classification, phylogeny, and economic aspects of grasses, identification of grasses

Courses for Graduate Students, major or minor

624. Physiology of Fungi. (2-0) Cr 2 Alt S, offered 1982 *Prereq 406, Chem 331 or B B 301* Nutrition, metabolism, growth, reproduction, and morphogenesis of fungi

641, 642. General Mycology. (2-6) Cr 4 each Yr *Prereq PP SW 407, or 416, or 417* Tiffany Taxonomy, morphology, and phylogeny of slime molds and fungi (phycomycetes, ascomycetes, basidiomycetes, and fungi imperfecti)

679. Light and Scanning Electron Microscopy. (2-12) Cr 6 F *Prereq Chem 331, permission of instructor* Horner Current theories and methods encompassing light and scanning electron microscopy of biological specimens Chemical and physical preparations, histochemistry, autoradiography, photomicrography, cytophotometry, and ancillary techniques Fee

680. X-ray Microanalysis Using Scanning Electron Microscopy. (1-9) Cr 4 Alt S, offered 1983 *Prereq 679, permission of instructor* Horner Qualitative X-ray microanalysis of biological specimens Bulk and sectioned specimen preparation Use of transmitted electron detection system Fee

681 Transmission Electron Microscopy. (2-12) Cr 6 Alt S, offered 1982 *Prereq Chem 331, Bot 679 and permission of instructor* Horner Current theories and methods encompassing transmission electron microscopy of biological specimens Chemical and physical preparations, negative staining, shadowing, replicas, ultramicrotomy, E M cytochemistry, and EMG analysis Fee

684 Plant Ecology Colloquium. (2-0) Cr 2 each time taken F S *Prereq Permission of instructor* Discussion of ecological literature and research, term paper and oral presentation, different topic chosen by instructor each semester

695 Advanced Plant Taxonomy (2-0) Cr 2 Alt S, offered 1982 *Prereq 306, Gen 320* Isely Literature and philosophy of biological classification, processes of speciation in higher plants, sources and interpretation of data, research methods, and plant nomenclature

698. Seminar Cr 1 each time taken Meetings of botany staff and students to discuss recent literature and problems under investigation
A Morphology and Taxonomy
B Plant Physiology
D For all staff and students in botany
E Molecular, Cellular, and Developmental Biology (MCDB)
F Ecology
G Economic Botany
J Cytology
K Aquatic Plant Biology

699 Research
A Morphology
B Physiology
D Mycology
E Taxonomy
F Plant Ecology
G Economic Botany
J Cytology
K Aquatic Plant Biology

*Courses Offered at the Iowa Lakeside Laboratory

301L. (L:101) Field Biology. (4-12) Cr 2 5 SS A study of plants in natural environments, includes methods of identification, collection, and preservation as well as basic ecological concepts Field trips Must be taken concurrently with Zool 302L

490. Independent Study. (See preceding section)

500L. (L:109) Biology of Algae. (8-24) Cr 5 SS *Prereq 10 credits in biological sciences* Role of algae in freshwater habitats, environmental factors affecting growth and reproduction, introduction to morphology of major groups of algae Field trips

559L. (L:119) Biology of Bryophytes and Pteridophytes. (8-24) Cr 5 Alt SS, offered 1983 *Prereq 10 credits in biological science* Farrar Collection and identification of mosses, clubmosses, spikemosses, quillworts, horsetails, and ferns Analysis of microclimates, soils, and community structure, with the goal of explaining and predicting species occurrence

564L. (L:124) Aquatic Vascular Plants. (8-24) Cr 5 Alt SS, offered 1982 *Prereq. 306, Biol 312* van der Valk Techniques for surveying aquatic vascular plant communities Collection and identification of specimens Environmental factors affecting distribution

567L. (L:105) Plant Taxonomy. (8-24) Cr 5 SS *Prereq 10 credits in biological science.* Basic principles of classification and evolution of vascular plants Taxonomic tools, techniques, and the native flora Group projects

575L. (L:115) Field Mycology (8-24) Cr 5 Alt SS offered 1982. *Prereq 5 credits in botany* Tiffany Collection and taxonomy of fungi and relation of their occurrence to environmental factors. Preparation and use of mycological exsiccati Field trips

580L. (L:117) Ecology and Systematics of Diatoms. (8-24) Cr 5 SS *Prereq 10 credits in biological science* Field experience in the study of freshwater diatoms Environmental factors affecting growth and distribution are stressed Techniques, collection, and preparation of diatom samples

590. Special Topics. (See preceding section)

699. Research. (See preceding section)

*Written permission of the instructor is prerequisite to all courses offered at the Iowa Lakeside Laboratory For current information concerning courses, registration, and housing, see the annual Iowa Lakeside Laboratory Bulletin. This bulletin is usually available from participating departments after February 15. Numbers beginning with L indicate numbers used by the University of Iowa

**Courses Offered at the Gulf Coast Research Laboratory, Ocean Springs, Mississippi

341G. (BO 341) Marine Botany Cr 4 *Prereq 10 credits in biology, including botany* A survey, based upon local examples of the principal groups of marine algae and marine flowering plants, treating structure reproduction, distribution, identification, and ecology

441G (BO 441) Salt-Marsh Ecology. Cr 4 *Prereq A course in general botany, 10 credits in biology* Emphasis on the botanical aspects of local marshes Plant identification, composition, structure, distribution and development of coastal marshes Biological and physical interrelationships Primary productivity and relation of marshes to estuaries and associated fauna

**Written permission of the coordinator of the Gulf Coast Research Laboratory, 201 Bessey Hall, Iowa State University, Ames, Iowa 50011, is prerequisite to all courses offered at the Gulf Coast Laboratory Numbers beginning with BO are GCRL numbers.

School of Business Administration

Charles B Handy, Director

Professors: Brown, Handy, Hoover, Loudenback, Shadle, Zober

Emeritus Professors: Schrampfer, Thompson

Associate Professors: Aitchison, Allen, Cheney, Elvik, Millard, Stover, Teas, Vellenga, Voorhees

Assistant Professors: Chacko, Crum, Curtis, Dellva, Kinker, Lund, Maydew, McElroy, Morrow Murphy, Powers, Smith, Van Auken, Wong

Undergraduate Study

The School of Business Administration has two major programs The Bachelor of Business Administration (BBA) degree, with 5 majors, offers a comprehensive in-depth program of study in business to prepare students for professional careers in specialized functions of business and government Candidates for this degree must satisfy the requirements established by the College of Sciences and Humanities (See *Sciences and Humanities Curriculum in Business Administration)* and also the requirements for individual majors specified by the School of Business Administration.

The Bachelor of Science (BS) degree, with a major in business administration, offers a broad

program of liberal study within the curriculum requirements of the College of Sciences and Humanities to prepare students with a broader and more diversified background for business, government, and graduate studies (e g law, professional studies, public administration, and others) Candidates for this degree must satisfy the requirements established by the College of Sciences and Humanities (See *Sciences and Humanities Curriculum)* and also additional courses specified by the School Beginning in 1983 students should be aware that there will be a foreign language requirement for the B S degree (see *Sciences and Humanities Curriculum* for basic education requirements) Students majoring in business administration will include the following,courses (in addition to those required by the College of Sciences and Humanities) to meet the general education requirements 3 credits in philosophy or religious studies, Sp 211, Math 150, 151, Stat 227, 3 credits in computer science, Econ 201 and one of Econ 304, 401, or 404 They will be required to take 27 credits of core business administration courses and 21 other credits (including 5 upper level courses in at least 3 of the following majors. accounting, finance, management, marketing, and transportation/logistics and an additional 6 credits to be designated by the student and the adviser)

Graduate Study

The School of Business Administration participates in an interdisciplinary program of Industrial Administrative Sciences (IAS) This program offers a Master of Science degree in industrial administrative sciences as well as minor work for students in other programs Undergraduate courses open to graduate students for minor credit only Mgmt 372, 373, 374 470, 471, 479, Acct 480, 481, 485, 486, 488 Mkt 440, 444, 445, 447, 449, Fin 451, 452, 454 455, 456, 457, 459 TrLog 460, 462, 464, 468, 469

In addition, the School of Business Administration participates in the interdepartmental graduate program in Transportation Planning (See Index)

Business Administration Courses for Undergraduate Students (BusAd)

100 Orientation (1-0) Cr R F S First 4 weeks Explanation and description of advising, reviewing transfer credits, planning academic programs and preclassifying

110 Introduction to Business. (3-0) Cr 3 F S Introduction to business in a modern society Major functional areas of business Emphasis on the American business system and its interaction with the environment

200 Introduction to Careers in Business (1-0) Cr R F S 8 weeks *Prereq Sophomore classification* Introduction and orientation to business majors and career fields open to business administration students

300 Cooperative Education Cr R Required of all cooperative students *Prereq Permission of department chairman* Students must register for this course prior to commencing each work period

Accounting Major

The primary purpose of accounting is to provide relevant information to both internal users (management) and external users such as investors, creditors, government, and the general public Accounting is an integral part of the management of business and public organizations Accountants, therefore, participate in planning, evaluating, and controlling the activities of the firm Accounting is needed by external users in order to make investment decisions, grant or withhold credit, and, in the case of government, to collect revenue and gather statistical information In order to provide useful information, accountants collect, analyze, synthesize, and report data in an understandable manner

The major in accounting is designed to give students a conceptual foundation as well as to provide a wide range of basic skills and analytical tools for use in reporting for both public and private concerns Students who complete the accounting major are well prepared to accept positions in industry, government, and the public accounting profession Completion of this program meets the current educational requirements for taking the CPA examination as established by the Iowa Board of Accountancy

The requirements for the accounting major are met by successful completion of the following courses. Acct 284, 285, 386, 387, 480, 485, 496, and 497, plus one from Acct 481, 486, 488, and 499

In addition, it is highly recommended that an accounting major include Business Law II (Mgt 316)

Accounting Courses Primarily for Undergraduate Students (Acct)

***284 Principles of Accounting** I (3-0) Cr 3 F S SS Introduction to the basic concepts and procedures of financial accounting The accounting cycle, business terminology, basic control procedures, and the preparation and evaluation of financial reports, including those of corporations

285 Principles of Accounting II (3-0) Cr 3 F S SS *Prereq 284* The essentials of managerial accounting Methodology and uses of internal managerial reports in cost determination, cost control pricing, and long-range planning

***381 Industrial Accounting** (2-0) Cr 2 F S Theory and practice of general accounting general survey of objectives and procedures of managerial accounting A terminal course designed for students not planning further study in accounting This course does not meet prerequisite for 285 or 480

386 Intermediate Accounting I (3-0) Cr 3 F S SS *Prereq 285* The conceptual framework of financial accounting Communication of financial information on the income and retained earnings statements, statement of changes in financial position and the balance sheet Accounting concepts relating to current and operational assets of the firm

387 Intermediate Accounting II (3-0) Cr 3 F S SS *Prereq 386, Fin 350* Accounting theory and practice related to corporation formation and operation analysis of incomplete records liabilities, pension costs leases, price level adjustments, application of concepts of present value, current issues in financial accounting

480 Cost Accounting (3-0) Cr 3 F S SS *Prereq 285* Product costing and control as related to job order process, and standard cost systems Introduction to cost-volume-profit relationships, operational budgeting, and responsibility accounting

481 Advanced Cost Accounting (3-0) Cr 3 F S *Prereq 480* Further development of product costing and control procedures Includes variable costing, capital budgeting, distribution costs, investment and profit centers Transfer pricing, inventory planning, decision models, mix and yield variances Field trips

485 Federal Income Tax. (3-0) Cr 3 F S SS *Prereq 381 or 284* Emphasis on fundamentals of income tax related to an individual taxpayer Transaction planning to maximize participation in preferential tax opportunities Limited exposure to characteristics of estate and gift taxes Introduction to concepts involved in taxation of corporations and partnerships

486. Advanced Income Tax. (3-0) Cr 3 F S *Prereq 386, 485* Extended study for those with a professional interest in income tax Taxation of corporations, partnerships, estates and trusts as well as more specialized provisions applying to individuals. Research in tax Preparation of returns including complex transactions

488 Governmental and Non-profit Institution Accounting. (3-0) Cr 3 S *Prereq 285* Budgeting, accounting, auditing, and financial reporting principles associated with private and public nonprofit organizations Includes survey of state, local, municipal, and federal government accounting, college, university, and endowment funds

490. Independent Study. Cr 1 to 3 each time taken *Prereq Senior classification, permission of instructor*

496. Advanced Accounting Problems. (3-0) Cr 3 F S *Prereq 387* Partnerships, branch operations, accounting for business combinations and affiliated companies, consolidated financial statements, reporting for multinational operations, installment sales, bankruptcy and corporate reorganization, estates and trusts

497 Auditing I (3-0) Cr 3 F S *Prereq 387, senior classification* The conceptual framework of auditing Rules of conduct External reporting concepts Audit methodology including procedures for gathering evidence Internal control, audit verification, and the role of statistical sampling in auditing for financial information systems

499 Auditing II (3-0) Cr 3 F S *Prereq 497* The application of auditing procedures in the review of the financial affairs of business The utilization of computerized system controls For students with a strong professional interest in auditing

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***Credit for both 381 and 284 may not be applied toward graduation**

Finance Major

The courses in finance constitute a broad program of study designed to provide a descriptive, behavioral, and analytical background of financial management to enable students to qualify for opportunities in banking, insurance, brokerage, government, real estate, and financial management of business enterprises Finance is also an excellent area for those who wish to become more knowledgeable as consumers, particularly in the fields of investments, insurance, and real estate

Areas of study in the field of finance include financial management, investments, insurance, real estate, banking, and security analysis Upper level courses include a review of contemporary literature in the field, case studies, and financial problem analysis integrating finance courses previously taken

Major requirements Fin 350, 452, 454, five courses from Fin 351, 357, 358, 451, 455, 456, 457, 459, Acct 386, 387, 480, 485, Mgmt 316 The School of Business Administration should be consulted for information on specific alternative plans of study

Finance Courses Primarily for Undergraduate Students (Fin)

350 Business Finance. Cr 3 F S SS *Prereq: Acct 285, Econ 201, Stat 227.* Introduction to financial management with emphasis on corporate financial decision making, financial statement analysis, time value of money, asset management, valuation of the firm, and use of funds.

351 Real Estate Principles. (3-0) Cr 3 F S SS *Prereq Econ 201* Legal, economic, and social aspects of real estate, including property rights, contracts, mortgage instruments, deeds, liens, property insurance, tax factors, brokerage, property management, home ownership, and basic concepts of real estate valuation

357 General Insurance. (3-0) Cr 3 F S SS *Prereq Econ 201* Risk and risk bearing as applied to individuals and business firms Insurance and probability Fundamentals of insurance contracts with special emphasis on life and health, and some study of automobile insurance

358. Management of Financial Institutions. (3-0) Cr 3. F *Prereq 350 and Econ 304* Analysis of operations of financial institutions from management viewpoint. Emphasis on organization, policy formation, asset and liability accounts, control of capital funds.

451. Real Estate Finance. (3-0) Cr 3 S. *Prereq: 351* Decision making in the financing of real estate using

basic analytic tools including the applications of various compound interest tables. Principal instruments involved in financing real estate, risk and return analysis, financing techniques, and major institutional sources of funds.

452. Advanced Business Finance. (3-0) Cr 3 F S *Prereq: 350.* Theory used in a firm's investment and financing decisions. Analysis of environment in which financial decisions are made, applications of analytical techniques to problems involved in financial decisions

454. Principles of Investments. Cr 3 F S.SS *Prereq. 350, Econ 201* Introduction to various investment media and markets from the viewpoint of the individual investor Emphasis on financial planning, behavior of security markets, corporate stocks and bonds, individual asset and portfolio selection techniques Term project required

455. Security Analysis. Cr 3 Alt S , offered 1982 *Prereq 454.* Analysis of key variables that affect security value Development of investment strategies Fundamental and technical analysis Emphasis on modern portfolio theory based on capital market theory Term project required

456. Property and Casualty Insurance. (3-0) Cr 3 Alt F , offered 1981 *Prereq: 357* Appraisal of property and casualty risks of individual and business organizations Underwriting of risks

457. Life Insurance. (3-0) Cr 3 Alt F , offered 1982 *Prereq: 357* In-depth analysis of health, social, and life insurance Major emphasis on group policies, retirement plans, business uses of life insurance, and estate planning

459. Finance Seminar. (3-0) Cr 3 F S *Prereq 452, 454* Contemporary problems and current research in financial management Readings from current periodicals, problem and case analysis investigating those areas requiring financial decisions

490. Independent Study. Cr 1 to 3 each time taken. *Prereq Senior classification, permission of instructor*

Management Major

Management is a broadly defined discipline and as a result numerous courses of study are incorporated within this major To assist students in selecting course combinations that will appropriately match student interests with career opportunities, alternative plans of study in management have been developed Students are encouraged to select either a generalized (general management) or one of several specialized study alternatives (behavioral, management science, management information systems, venture management). The former is designed to provide management majors with an overview of the management of business organizations, while the latter are offered in order to provide students some area of expertise within this broad discipline

All students majoring in management are required to successfully complete the following courses. Mgmt 315, 318, 370, 371, and 478 plus 6 courses as determined by the student's selected plan of study Recommended courses for students majoring in management include Acct 480, 481, 485, Com S 211, 221, 332, 375, 441, Econ 404, 445, Fin 351, 357, 452, I E 312, 475, Math 307, Mgmt 316, 372, 373, 374, 414, 415, 470, 471, 479, 490; Mkt 441, 442, 445, 447, Psych 313, 450; Soc 380, 480, 486, Sp 314, 315; TrLog 460, 468 The School of Business Administration should be consulted for information on the specific alternative plans of study

Management Courses Primarily for Undergraduate Students (Mgmt)

213. Small Business Management. (3-0) Cr 3 F *Prereq: Econ 201.* Operation of a small business. Financing, marketing, management, and record keeping Emphasis on the importance of small business to the economy

315. Business Law I. (3-0) Cr 3 F S.SS Fundamental principles of law as applied to business transactions and business relationships. Our legal system as an agency of social control, good business technique and practice The court system, administrative agencies, contracts, and agency

316. Business Law II. (3-0) Cr 3 F S *Prereq 315* Continuation of Mgmt 315 Sales under the Uniform Commercial Code, negotiable instruments, secured transactions, property transactions, partnerships, and wills and estates

318. Quantitative Methods in Business. (3-0) Cr 3 F S. *Prereq Stat 227, Math 150, 151* Application of quantitative techniques to managerial problems Decision theory, inventory models, queuing theory, programming models, network models simulation, and game theory Computer application of various techniques

370. Principles of Organization and Management. (3-0) Cr 3 F S SS *Prereq: Econ 201, sophomore classification* Basic principles, concepts, and practices of management used in organizations

371. Individual Behavior in Organizations. (3-0) Cr 3 F S SS *Prereq 370* Behavior of employees in work organizations, motivation of individuals to join and perform in organizations and the relationship of employee satisfaction to elements of the work environment. Emphasis on various management strategies for managing employee behavior

372. Introduction to Management Information Systems. (3-0) Cr 3 F S *Prereq 370, Com S 111 or 172 or 175* Computer-based management information systems and how such an information system supports decision-making at all levels of management The development, organization, management control, and evaluation of information system activities, societal implications of the use of the computer in business

373. Applications in Business Information Processing. (3-0) Cr 3 F S. *Prereq: 370, Com S 201* Design and development of business applications in COBOL COBOL and its use in developing data processing applications, methods or storage for processing and information retneval purposes, availability of generalized software packages, and the information interface with other functional areas of business.

374. Business Information Systems Analysis. (3-0) Cr 3 S *Prereq 372* Feasibility studies, identification of management decision requirements, approaches and techniques for the analysis and description of information flows, and managenal control of business system development

413 Venture Management. (3-0) Cr 3 F *Prereq 370, Mkt 340, Fin 350* Study of the effective management of business ventures, strategy determination, planning and controlling functions Emphasis on the unique aspects of venture management Feasibility study of an enterprise required

414. International Business Management. (3-0) Cr 3 S *Prereq 370, Mkt 340, Fin 350* The nature and economic role of the multinational firm, including the impact of legal, political, and cultural variables upon firm performance and managenal activity, case studies illustrate interdependent nature of functional areas of business projected across national boundaries

415. Small Business Investigations. (3-0) Cr 3 F S *Prereq 478 recommended* An examination and analysis of small business problems Development of problem-solving and decision-making skills related to small business operations through field study

416. Legal Environment of Business. (3-0) Cr 3 S *Prereq: 370, 315* Introduction and analysis of topical legal environment of business. The court system and litigation, constitutional problems, administrative and legislative process, regulation, employment practices, legal aspects of management-labor relations, business tort law, and creditor-debtor relationships

470. Organization Theory. (3-0) Cr 3 F S *Prereq 371* A macro view of organizations Emphasis on the organization itself, rather than on people in organizations Existing theoretical frameworks are employed to better understand why organizations are structured as they are and why they behave as they do

471 Current Issues in Management. (3-0) Cr 3 F S *Prereq 371* Current issues impacting on employer-employee relations, governmental, union, and societal influences Emphasis on the nature of the current problematic issues, their impact, and alternative coping strategies.

478. Business Policy. (3-0) Cr 3 F S SS. *Prereq 318, 370, Acct 285, Fin 350, Mkt 340, TrLog 360, senior classification* Strategic concepts and policy issues in modern business, emphasis on the role of executive decision-making as simulated by the case-study method

479. Management Seminar. (3-0) Cr 3 S *Prereq Senior classification in management, permission of the instructor* Selected problems in management

490. Independent Study. Cr 1 to 3 each time taken *Prereq: Senior classification, permission of instructor*

Marketing Major

Marketing is concerned with business decisions that deal with the satisfaction of consumer needs in the purchase of goods and services The primary decision areas in marketing involve the identification of market segments and decisions dealing with product design, pricing, promotion, personal selling, location of facilities, and distribution A major in marketing prepares the student for careers in product management, industrial purchasing, advertising and sales promotion, marketing research, personal selling and sales force management as well as for careers in nonprofit sectors of the economy such as charitable and government organizations Career opportunities are available for students who are skilled in either quantitative or behavioral techniques

The courses required for a marketing major are. Mkt 340, 442, 443, 444, 447

In addition to the required courses the student must take three of the following elective courses Mkt 343, 410, 440, 445, 446, 449, TrLog 460

Marketing Courses Primarily for Undergraduate Students (Mkt)

340. Principles of Marketing. (3-0) Cr 3 F S SS *Prereq Econ 201, junior classification, Acct 381 or 284 recommended* Market forces that affect the marketing decision-making processes. managenal, social, and international aspects of marketing

343. Personal Sales. (3-0) Cr 3 F S.SS *Prereq 340* Fundamentals of personal sales with emphasis on the importance of self-confidence, control in human interactions, and sales techniques, simulations of selling situations

410 Promotional Strategies. (3-0) Cr 3 F S *Prereq 447* Need for coordination among a variety of promotional elements advertisement, personal sales, public relations, and sales promotions

440. Industrial Purchasing. (3-0) Cr. 3 F SS *Prereq 340* Principles and policies of industrial purchasing Emphasis on materials management Cases and a VAX interactive simulation

441 Marketing Management. (3-0) Cr 3 F S SS *Prereq 340* Introduction to use of marketing techniques in analysis of business decisions dealing with pricing, advertising, personal selling, product development, and channels of distribution

442. Sales Management. (3-0) Cr 3 F S SS *Prereq 447* Functional aspects of sales force management. procedures for recruiting, selecting, and training new salesmen, compensation and expense control systems. problems of sales force motivation and supervision, methods of territorial and quota assignment, sales department budgets, distribution-dealer relations, other selected topics

443. Strategic Marketing Management. (3-0) Cr 3 F S SS *Prereq: 444* Analysis of major elements of strategic marketing management Emphasis on case studies involving decision making using marketing tools from previous courses and marketing research techniques

444. Marketing Research. (3-0) Cr 3 F S SS *Prereq 447, Stat 228* Marketing research techniques. problem formation, research design, questionnaire construction sampling, date collection procedures, and analysis and interpretation of data related to marketing decisions

445. Sales Forecasting. (3-0) Cr 3. S. *Prereq 340, Stat 228 recommended.* Time series, analysis by regression exponential smoothing, cycle analysis, and other mathematical models, by using an interactive program on a VAX terminal and case analysis.

446. Retailing. (3-0) Cr 3 F S.SS *Prereq 340* Basic areas of retail management: buying, merchandising, retail promotion, store location, store layout, credit management, and inventory control Emphasis on practical application of retail management principles

447 **Consumer Behavior.** (3-0) Cr 3 F S SS *Prereq 340* Application of concepts and methods of the behavioral sciences to marketing management decision making

449 **Marketing Seminar.** (3-0) Cr 3 S *Prereq. 447* Analysis of current problems in marketing with emphasis on new theoretical and methodological techniques for solving these problems

490 **Independent Study.** Cr 1 to 3 each time taken *Prereq Senior classification, permission of the instructor required for enrollment and for use of the course as an elective for a marketing major*

Transportation/Logistics Major

The study of transportation and logistics (physical distribution) serves three purposes First, it addresses the importance of the transportation and logistics systems in the social and economic development of the nation Second, it serves as a specialized program for those who plan careers in transportation with industry, carriers, and government agencies Third, it is a broad educational program which emphasizes the managerial aspects of transportation and logistics systems and concepts rather than the specifics of day to day operations The requirements for the transportation/logistics major are met by successful completion of the following courses 360, 362, 460, 462, 468, 469, Mkt 441, and either C E 350 or TrLog 464

Transportation/Logistics Courses Primarily for Undergraduate Students (TrLog)

360 Principles of **Transportation and Logistics.** (3-0) Cr 3 F S SS *Prereq Econ 201 and sophomore classification* The transportation function and logistics concept, inventory, packaging, warehousing, communications, pricing and location Emphasis on transportation management, economics, pricing, and role in U S economy

362. **Transport Economics.** (3-0) Cr 3 F *Prereq 360* Theory and application of transport pricing, nature of the cost and demand functions of railroads, motor carriers, pipelines, airlines, and water carriers, economic dimensions of service application of cost-benefit analysis (including problems of measuring company and social costs), nature, effects, and policy implications of market structure

460 **Logistics Management.** (3-0) Cr 3 F S *Prereq 360* Advanced business logistics, stressing materials management and quantitative approaches to design and operation of the total logistics system Evaluation and solution of logistics cases

462. **Transportation Carrier Management.** (4-0) Cr 4 F S *Prereq 360* Functions, roles and management decisions for air, water, motor, railroad, and pipeline modes Regulatory policies, ownership and management problems, pricing, labor, and competitive relationships

464. **Urban and Rural Transportation Management.** (3-0) Cr 3 F *Prereq 360* Urban and rural passenger transportation from a managenal viewpoint Analyses of transit operations, financing, marketing, personnel, and labor problems, federal and state aid, and a contrast between urban and rural transportation

468. **Transportation and Public Policy.** (3-0) Cr 3 F S *Prereq 360, 462 and senior classification.* Analysis of current major issues and of pertinent studies on national policy, including recent and proposed legislation Evaluation of impact of policy changes on carriers and economy Individual projects required

469. **Transportation & Logistics Seminar.** (3-0) Cr 3 F S *Prereq 460, 464, 468 and senior classification* Research in contemporary problems in transportation and logistics

490 **Independent Study.** Cr 1-3 each time taken *Prereq Senior classification.* Permission of instructor required for enrollment and for use of the course in the Transportation/Logistics major.

Courses Primarily for Graduate Students, major or minor. Open to qualified undergraduates.

Mgmt 510. Business and Social Responsibility (3-0) Cr 3 F *Prereq. 370.* Designed to stimulate critical evaluation of business' role in society, ethical, managerial, governance, and public issues as they affect the corporation

Mkt 540 Advanced Marketing Management. (3-0) Cr 3 S *Prereq 340* Strategic marketing planning and decision making, with emphasis on use of quantitative techniques and marketing models

Fin 550 Financial Management. (3-0) Cr 3 F *Prereq 350* Financial management problems, relationship of finance with other functions within the firm, including practical and theoretical methods of financial analysis as part of a system of management decisions

TrLog 560. Transportation and Logistics Seminar (3-0) Cr 3 F *Prereq 360* Management of transportation and logistics within contemporary business, case analysis used

Mgmt 578 Management Policy Making. (3-0) Cr 3 S *Prereq 540, 550, 560, 580, I E 551* Formulation and application of management policy in organizations Emphasis on analysis and solution of cases utilizing knowledge acquired in studying functional areas of business Complexity of business problems and interaction of business functions

Acct 580 Accounting Management. (3-0) Cr 3 S *Prereq 285 or 381, permission of instructor* Importance of accounting information in business decisions Management's use of planning and control concepts as they apply to all types and functions of organizations

BusAd 590 Special Topics. Cr 1 to 5 each time taken F S SS *Prereq Permission of instructor* For students who wish to do individual research in a particular area of business

A Accounting
B Finance
C Management
D Marketing
E Transportation/Logistics

Chemical Engineering

Maurice A Larson, Chair of Department

Professors: Abraham, Arnold, Bautista, Boylan, Burkhart, Burnet, Gill, Hill, Larson, Pulsifer, Reilly, Seagrave, Wheelock

Associate Professors: Collins, Glatz, Jolls, Schrader, Shearer, Sheeler, Ulrichson

Undergraduate Study

For undergraduate curriculum in chemical engineering leading to the degree Bachelor of Science, see *College of Engineering, Curricula*

Chemical engineering is a profession which provides a link between scientific knowledge and man-made products The chemical engineer relies on science, experience, creativity, and ingenuity to produce these materials economically Almost everything of a material nature used by society today has at some point felt the influence of the chemical engineer From raw materials such as minerals, coal, petroleum, and agricultural products, chemical engineers create new forms of fuels, new materials for construction, pharmaceuticals, foodstuffs, synthetic textiles, plastics, solid state electronic components, and dozens of other materials The chemical engineer's influence has been felt in the development of nuclear energy, fuel cells, automatic controls, biochemical processes, artificial kidneys and other medical-related devices, as well as in the development of air and water pollution control systems Many new and equally exciting challenges await the practicing chemical engineer of the future

The profession of chemical engineering embraces a wide variety of activities including research, process development, product development, design, manufacturing supervision, technical sales, consulting, and teaching The engineer can be behind a desk, in a laboratory, in a manufacturing plant, or engaged in nationwide and worldwide travel

Successful chemical engineers find chemistry, mathematics, and physics to be interesting and exciting The curriculum in chemical engineering includes continued study of chemistry, mathematics, and physics as well as intensive study in the engineering sciences such as thermodynamics, heat transfer, mass transfer, fluid mechanics, system analysis and process synthesis, and design

A cooperative education program is available to students in chemical engineering See *Cooperative Programs, College of Engineering*

Graduate Study

The department offers work for the degrees Master of Science, Master of Engineering, and Doctor of Philosophy with major in chemical engineering, and minor work to students taking major work in other departments

Prerequisite to major graduate work is the completion of an undergraduate curriculum substantially equivalent to that offered in chemical engineering at this institution.

The Master of Engineering degree requires an independent study project A thesis is required for the Master of Science degree

Interdepartmental programs between chemical engineering and biomedical engineering are provided under the sponsorship of the colleges of Engineering and Veterinary Medicine Laboratory facilities are available in both biomedical engineering and chemical engineering See *Biomedical Engineering*

The department also participates in the interdepartmental program of Water Resources, and in the interdepartmental minor program of Energy Systems Engineering (See Index)

Open to graduate students for minor credit only 320, 321, 322, 324, 325, 331, 332, 410, 415, 421, 426, 430, 441, 442, 443, 444

Courses Primarily for Undergraduate Students

201, 202. **Seminar.** (1-0) Cr R Yr *Prereq Sophomore classification in chemical engineering* Offered on a satisfactory-fail basis only

210. **Material and Energy Balances.** (4-0) Cr 4 F S *Prereq Chem 178* Introduction to chemical processes Physical behavior of gases, liquids, and solids. Application of material and energy balances to chemical engineering equipment and processes.

298, 398, 498. **Cooperative Education.** Required of all cooperative students *Prereq. Permission of department chairman* 298 Work periods for students with sophomore standing in a regularly established program 398 Work periods for juniors. 498 Work periods for seniors Students must register for these courses prior to commencing each work period

301, 302. **Seminar.** (1-0) Cr R. Yr *Prereq Junior classification in chemical engineering* Offered on a satisfactory-fail basis only

313. **Unit Operations.** (2-2) Cr 3 S *Prereq: Chem 167, Math 266, Phys 222* Material and energy balances, fluid flow, heat and mass transfer, stage operations and system analogs Not acceptable for credit for a chemical engineering degree.

320. **Momentum Transport Operations.** (3-0) Cr 3 F S *Prereq. 210, Com S 172, Phys 221, credit or classification in Math 267* Momentum and mechanical energy balances Incompressible and compressible fluid flow Applications to fluid drag, piping system design, filtration, packed beds and settling

321. Heat and Mass Transfer. (3-0) Cr 3 F S *Prereq 320.* Conduction and diffusion, convective heat and mass transfer, boiling and condensation, radiation, simultaneous heat and mass transfer, design of heat exchange equipment.

322. Mass Transfer Operations. (4-0) Cr 4 F S *Prereq 321* Analysis and design of continuous contacting and multistage separation processes Binary and multicomponent distillation, absorption, extraction, evaporation

324. Chemical Engineering Laboratory I. (0-2) Cr 1 S *Prereq, Credit or classification in 320* Experiments covering basic chemical engineering measurements, material and energy balances, and momentum transport operations Computer applications

325. Chemical Engineering Laboratory II (0-2) Cr 1 S *Prereq 324, credit or classification in 321 and 332* Experiments in heat and mass transfer, thermodynamics, and chemical reactor performance

331. Chemical Engineering Thermodynamics. (4-0) Cr 4 F S *Prereq 210, Math 267, Phys 222* Application of thermodynamic principles to chemical engineering problems Energy and entropy balances Thermodynamic properties of fluids, phase equilibria, chemical reaction equilibria

332. Chemical Reactor Design (3-0) Cr 3 F S *Prereq 331, credit or classification in 321* Kinetics of chemical reactions, design of homogeneous and heterogeneous chemical reactors

391. Foreign Study. (1-0) Cr 1 S *Prereq 320, permission of instructor* Preparation for foreign study program Offered on a satisfactory-fail basis only Credit for graduation allowable only upon completion of 392

392. Foreign Study Program. Cr 4-6 SS *Prereq 391* Study of chemical engineering including laboratories and lectures at University College London Comparative study of U S and U K manufacturing facilities Expenses required Offered on a satisfactory-fail basis only

401, 402 Seminar (1-0) Cr R Yr *Prereq Senior classification in chemical engineering* Offered on a satisfactory-fail basis only

410. Chemical Process Industries. (3-0) Cr 3 S *Prereq Chem 331* Functioning of the chemical process industries raw materials, process routes, intermediates, products, economics and marketing

415. Biochemical Engineering. (3-0) Cr 3 S *Prereq Chem 331* Application of basic chemical engineering principles in biochemical and biological process industries such as fermentation, food processing, enzyme technology, and biological waste treatment

421. Process Control. (2-2) Cr 3 S *Prereq Credit or classification in 322, Math 267* Control of industrial chemical processes Devices applications and limitations Dynamics of chemical process components and process control systems

426. Chemical Engineering Laboratory III. (0-3) Cr 1 F *Prereq 322, 325* Investigation of chemical engineering process equipment

430 Process and Plant Design. (2-6) Cr 4 F *Prereq 322, 332* Synthesis of chemical engineering processes, equipment and plants Cost estimation and feasibility analysis

441. Modeling and Simulation. (2-0) Cr 2 S *Prereq 322, 332* Simulation of behavior of chemical processes; trial and error calculations, numerical integration and other numerical methods Problems involving fluid flow, distillation, heat transfer, process control, and reactor design

442. Analog Computer Applications in Chemical Engineering. (1-3) Cr 2 S *Prereq 322* Applications of analog computers to the solution of problems arising in transport processes, chemical reactors, process dynamics, and equipment design

443. Polymers and Polymer Engineering. (3-0) Cr 3 F *Prereq 320, Chem 331* Chemistry of polymers, addition and condensation polymerization Physical and mechanical properties, polymer rheology, production methods. Fabrication and extrusion equipment operation. Applications of polymers in the chemical industry

444. Applied Instrumentation. (2-4) Cr 3 F SS *Prereq Phys 222* An introduction to measurement primarily for research students Coordinated lecture and laboratory exercises in basic circuit theory, signal processing, recording and readout devices, and fundamentals of analog and digital instrumentation. Lecture/demonstrations illustrate practical aspects of instrument selection and use.

490. Independent Study. (0-3 to 18) Cr 1 to 6 Introduction to research methods, investigation of an approved topic
H Honors

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

515. Coal Science and Technology. (3-0) Cr 3 Alt F , offered 1981 *Prereq Chem 321, 331* Physical and chemical properties of coal, methods of analysis, and characterization Industrial processes for cleaning, carbonizing, desulfurizing, gasifying, and liquefying coal to produce cleaner, more useful fuels

521 Process Dynamics. (3-0) Cr 3 S *Prereq 421* Application of dynamic analysis techniques in the study of nonsteady state chemical processes

530. Process Design and Optimization. (2-3) Cr 3 S *Prereq 430* Advanced process synthesis Optimum seeking methods applicable to process design and evaluation

531 Air Pollution (Mteor 531) See Meteorology

532. Air Pollution Control. (2-0) Cr 2 Alt F , offered 1982 *Prereq 322* Principles of gas purification and processes for the control of gaseous pollutants Mechanics of aerosols and principles of particulate removal from gases

545. Analytical and Numerical Methods. (3-0) Cr 3 F *Prereq 322, Math 267* Analysis of equipment and processes by analytic and/or numerical solution of descriptive differential equations Operational and series techniques, boundary value problems, numerical interpolation and approximation, integration techniques

552. Transport Phenomena and Momentum Transfer. (4-0) Cr 3 F *Prereq 321, 331, Math 267* Equations of change for mass, energy, and momentum according to phenomenological and molecular models Introduction to transport in multicomponent systems Exact and approximate solutions to the equations of motion One-hour weekly demonstrations

553. Heat and Mass Transport. (4-0) Cr 4 S *Prereq 552* Convective and radiative heat transfer, boiling, condensation, multicomponent diffusion, mass transfer models High transfer rate effects Simultaneous heat, mass and momentum transfer

583. Advanced Thermodynamics. (4-0) Cr 4 S *Prereq 331* Application of thermodynamic principles to chemical engineering problems Thermodynamic properties of non-ideal fluids and solutions, phase and chemical-reaction equilibria

587. Advanced Chemical Reactor Design. (3-0) Cr 3 F *Prereq 332* Kinetics of heterogeneous reactions Analysis and design of non-ideal flow and heterogeneous reactors

590. Special Topics. Cr 2 to 6 each time taken Investigation of an approved topic on an individual basis

595. Special Topics. Cr 2 or 3 each time taken *Prereq Permission of instructor* When offered with a letter suffix, the following letters are reserved for the topics listed
A Multicomponent Distillation
B Solvent Extraction
C Crystallization
D Thermodynamics
E Kinetics and catalysis
F Transport Operations
G Bioengineering

Courses for Graduate Students, major or minor

601 Seminar. (1-0) Cr R F S Offered on a satisfactory-fail basis only

645. Advanced Calculation Methods for Chemical Engineers. (3-0) Cr 3 *Prereq 545* Advanced analysis and design of equipment and processes requiring specialized mathematical techniques Alt S , offered 1983

652. Advanced Momentum Transport. (2-0) Cr 2 Alt S , offered 1982 *Prereq 552* Advanced topics in momentum transport and fluid mechanics including study of recent literature

653. Advanced Mass Transport. (2-0) Cr 2 Alt F , offered 1981 *Prereq 553.* Advaned topics in mass transport including study of recent literature

654. Advanced Heat Transport. (2-0) Cr 2 Alt F , offered 1982 *Prereq 553.* Advanced topics in heat transfer including study of recent literature.

683. Non-Equilibrium Thermodynamics. (3-0) Cr 3 Alt SS , offered 1983 *Prereq 552, 583* Thermodynamics of irreversible processes including diffusion and sedimentation, electrochemical processes, muscle contraction, thermal diffusion, and membrane transport

690. Advanced Topics. Cr var

699. Research.

Chemistry

Robert J Angelici, Chair of Department

Professors: Angelici, Barton, Corbett, Diehl, Espenson, Fassel, Franzen, Fritz, Gerstein, Gilman, Hansen, Hoffman, Hutton, Jacobson, D C Johnson, Martin, McCarley, Powell, Randic, Ruedenberg, Russell, Small, Svec, Trahanovsky, Verkade, Voigt

Emeritus Professors: Goetz, King, Spedding Wilhelm

Associate Professors: Edgar, Larock, Struve, Warner, Yeung

Assistant Professors: R P Johnson, Kraus, Kurtz, Ng, Walters

Undergraduate Study

For undergraduate curriculum in sciences and humanities leading to the degrees Bachelor of Science and Bachelor of Arts, see *Sciences and Humanities, Curriculum*

Graduates holding the B S degree in chemistry qualify in many fields as teachers of chemistry, as supervisors in industry, as technical sales personnel, and as research chemists in federal, state, municipal, academic, or industrial laboratories

The B A degree is useful for students who intend to pursue studies in parallel areas, such as secondary school teaching, or to obtain joint majors or strong minors The B A degree does not prepare students well for graduate study or professional employment in chemistry

Undergraduate chemistry students take not only studies in chemistry but also courses in mathematics, physics, German, or Russian, and in cultural subjects. Students with the necessary high scholastic standing usually continue with graduate work, where they can explore more thoroughly the specialized areas of chemistry in which they are interested

Undergraduate students seeking the B S degree in chemistry usually have the following basic courses or their equivalents in their program 177, 177L, 178, 210, 301, 316, 324, 325, 325L, 331, 332, 333B, 334B, 401L, 470 and 3 credits of advanced chemistry Several courses can be replaced. 210 by 211, 324, 325 by 321, 322 Students who transfer into the program after the freshman year often find these alternatives more convenient. A student may request permission to substitute elective courses for certain of the required courses The following courses are required as supporting work: Math 165, 166, 265 (or 175, 176, 270), Phys 221, 222 as a minimum (certain areas of chemistry specialization require considerably more mathematics and physics)

Undergraduate students seeking the B.A degree in chemistry usually have the following courses in their degree programs as minimum

requirements 177, 177L, 178, 211, 301, 312, 321, 321L, 322, 331, 332, 333A, 334A Math 165, 166 and Phys 111, 112 or 221, 222 are required as supporting work

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with majors in analytical, inorganic, organic, and physical chemistry, as well as the degrees Master of Science and Doctor of Philosophy in chemistry Co-majors may be taken between areas within chemistry or between one of the areas in chemistry and another department Courses in other areas of chemistry as well as courses in other departments may be used to satisfy the requirement for course work outside the major field Minor work is offered to students taking major work in other departments

The Department of Chemistry requires all graduate students majoring in chemistry to teach as part of their training for an advanced degree

Prerequisite to major graduate work is the completion of undergraduate work in chemistry, mathematics, and physics, substantially equivalent to that required of undergraduate students at this institution

For the Ph D degree, the foreign language requirement is reading proficiency in one of the following German, Russian, French, or, in some special cases, Japanese

Open to graduate students for minor credit only 301, 321, 321L, 322, 331, 332, 401L, 426

Index to field of work is given by the second and third digits of course numbers

(a) Inorganic Chemistry	00-09
(b) Analytical Chemistry	10-19
(c) Physical Chemistry	20-29
(d) Organic Chemistry	30-39
(e) General Chemistry	60-79
(f) Research	99

Courses Primarily for Undergraduate Students

50 **Preparation for General Chemistry** (2-0) Cr 0 F S SS *Prereq 1 year high school algebra* Basic methods and concepts of chemistry students must master before they are ready for college chemistry For students intending to enroll in general chemistry and who have not taken high school chemistry or have otherwise deficient backgrounds

*160 **Chemistry in Modern Society.** (3-0) Cr 3 S Aspects of chemistry visible to a nonscientist in our society A nonmathematical survey of selected areas of chemistry with emphasis on the interface between chemistry and other fields of human activity

*163, 164 **General Chemistry.** 163 (4-0) Cr 4 F S SS 164 (3-0) Cr 3 F S *Prereq 163 1 year high school algebra, credit or classification in 163L, high school chemistry or 50 recommended, 164 163 and 163L* Principles of chemistry and properties of matter explained in terms of modern chemical theory 163 stoichiometry, atomic structure, chemical bonding, energy relations, solution behavior, acid-base and oxidation-reduction reactions, kinetics and equilibrium, nuclear chemistry 164 liquids, solids, change of state, thermodynamics and equilibrium, electrochemistry, descriptive chemistry of metallic and nonmetallic elements, coordination compounds and organic molecules

*163L, 164L. **Laboratory in General Chemistry.** (0-3) Cr 1 each 163L F S SS, 164L F S *Prereq 163L. Credit or classification in 163, 164L. credit or classification in 164* Laboratory to accompany 163 and 164 163L must be taken with 163, 164L is not a necessary corequisite with 164

*167. **General Chemistry for Engineering Students.** (4-0) Cr 4 F S *Prereq: 50 or high school chemistry* Principles of chemistry and properties of matter explained in terms of modern chemical theory with emphasis on topics of general interest to the engineer This is a terminal course intended for students who do not plan to take additional courses in chemistry

*167L. **Laboratory in General Chemistry for Engineering.** (0-3) Cr 1 F S *Prereq Credit or classification in 167* Laboratory to accompany 167

*177, 178. **General Chemistry.** 177 (4-0) Cr 4 F S SS, 178 (3-0) Cr 3 F S *Prereq 177 50 or 1 year high school chemistry and credit or classification in 177L, 178. 177, 177L* Chemistry explored at a greater depth and with more emphasis on concepts, problems, and calculations than 163-164 Recommended for physical and biological science majors, chemical engineering majors and all others intending to take 300-level chemistry courses 177M, 178M For chemistry and biochemistry majors and qualified students seeking a strong emphasis in chemistry 177 Principles and quantitative relationships (stoichiometry, thermodynamics, changes of state, solution behavior, atomic structure, chemical bonding, electrochemistry and nuclear chemistry) 178 Acid-base chemistry, complex ion equilibria, rates and mechanisms of reactions, and descriptive topics (nonmetals, transition metals, coordination compounds, organic compounds, polymers, biological molecules)

*177L, 178L. **Laboratory in General Chemistry** (0-3) Cr 1 each 177L F S SS, 178L F S *Prereq 177L Credit or classification in 177, 178L Credit or classification in 178* Laboratory to accompany 177 and 178 177L must be taken with 177, 178L is not a necessary corequisite with 178 177N For chemistry and biochemistry majors

*210. **Quantitative Analysis.** (2-6) Cr 4 S *Prereq 177 and 177L* Theory and practice of elemental gravimetric, volumetric, chromatographic, and spectrophotometric analysis For chemistry and biochemistry majors and qualified students seeking a strong emphasis in chemistry

*211 **Quantitative Analysis** (2-6) Cr 4 F S SS *Prereq 163, 164 and 163L, or 177 and 177L* Theory and practice of elementary gravimetric, volumetric, chromatographic and spectrophotometric analysis Chemistry and biochemistry majors and students seeking a strong emphasis in chemistry should elect Chem 210

*231 **Elementary Organic Chemistry** (3-0) Cr 3 F S SS *Prereq 163, 163L, credit or classification in 232A or 232B* A survey of modern organic chemistry including nomenclature, structure and bonding, chemistry of hydrocarbons and important functional groups, reaction mechanisms, polymers fats oils carbohydrates, and proteins For students desiring only an elementary course in organic chemistry Students in physical or biological sciences, and premedical or preveterinary curricula are encouraged to take 331, 332 and 333A, 334A

232 **Laboratory in Elementary Organic Chemistry** A (0-3) Cr 1 B (0-6) Cr 2 F S SS *Prereq credit or classification in 231* A Laboratory techniques involving synthesis, qualitative and quantitative functional group analysis, and chemical and physical properties of dyes, polymers and biomolecules B Extension of material covered in A

301. **Inorganic Chemistry** (4-0) Cr 4 S *Prereq 324 or 321* Bonding in inorganic systems, descriptive and systematic chemistry of the elements Emphasis on correlation of structure and bonding with chemical or physical properties of inorganic compounds, applications of thermodynamics, kinetics, and other physical methods to study of inorganic systems

*312. **Instrumental Methods of Chemical Analysis.** (2-3) Cr 3 S *Prereq 211* Quantitative instrumental analysis as applied in the clinical laboratory Not accepted for credit toward B S degree in chemistry

*316 **Instrumental Methods of Chemical Analysis.** (2-6) Cr 4 F *Prereq 210* Quantitative and qualitative instrumental analysis Operational theory of instruments atomic and molecular absorption and emission spectroscopy, electroanalysis, liquid and gas chromatography, literature of chemical analysis

*321 **Physical Chemistry.** (3-0) Cr 3 F S *Prereq 210 or 211 or 178, Math 166 or Math 176, Physics 222 recommended* Kinetic theory of gases, classical thermodynamics with applications to gases, multicomponent, multiphase equilibrium of reacting systems, surface chemistry, and electrochemical cells Students majoring in chemistry or biochemistry will ordinarily elect Chem 324, 325

321L. **Laboratory in physical chemistry.** (1-3) Cr 2 F *Prereq Credit or classification in 321 recommended*

*322. **Physical Chemistry.** (3-0) Cr 3 F S *Prereq Chem 321 or 324* Solids, transport properties, chemical kinetics, quantum mechanics, atomic and molecular structure, spectroscopy, statistical thermodynamics

*324 **Physical Chemistry.** (3-0) Cr 3 F *Prereq. 210 or 211 or 178, Math 166 or 176, Physics 222 recommended* Kinetic theory of gases, classical thermodynamics with applications in gases, multiphase, multicomponent equilibrium of reacting systems, surface chemistry, and electrochemical cells For students majoring in chemistry or biochemistry

*325. **Physical Chemistry.** (3-0) Cr 3 S *Prereq Chem 324 or 321* Solids, transport properties, chemical kinetics, quantum mechanics, molecular structure and spectroscopy, statistical thermodynamics For students majoring in chemistry or biochemistry

325L. **Laboratory in Physical Chemistry.** (1-6) Cr 3 S *Prereq Credit or classification in 322 or 325 recommended*

*331, 332 **Organic Chemistry** (3-0) Cr 3 each 331 F S, 332 F S, 332C S *Prereq 331 178 or 210 or 211, classification in 333A highly recommended, 332 331, classification in 334A highly recommended* Modern organic chemistry including nomenclature, synthesis, structure and bonding, reaction mechanisms, natural products, carbohydrates and proteins For students majoring in physical and biological sciences, premedical and preveterinary curricula, chemistry and biochemistry

333, 334 **Laboratory in Organic Chemistry.** A (0-3) Cr 1 each B (0-6) Cr 2 each 333 F S, 334 F S *Prereq 333 credit or classification in 331, 334 333, credit or classification in 332* Chemistry and biochemistry majors should take 333B and 334B

399 **Undergraduate Research.** Cr var *Prereq Permission of staff member with whom student proposes to work*

401L. **Inorganic Chemistry Laboratory.** (0-4) Cr 1 F *Prereq 301* Preparation and characterization of inorganic and organometallic compounds by modern techniques For students majoring in chemistry or biochemistry

426 **Radiotracer Methods.** (2-0) Cr 2 F *Prereq 322 or 325, Phys 112* Radioisotope techniques and their applications to problems in biology and allied sciences For students in biology and agriculture

470. **Structure and Bonding.** (2-0) Cr 2 F *Prereq 325 or 322* Systematic development of orbital concepts for electronic structures in general molecular systems Explanation and prediction of chemical bonding patterns and molecular properties on the basis of such electronic structures Applications to various classes of inorganic and organic molecules

490. **Independent Study.** Cr var *Prereq Permission of instructor*

499. **Senior Research.** (0-6 or 0-9) Cr 2 or 3 each time taken *Prereq Permission of staff member with whom student proposes to work, B average in all chemistry, physics, and mathematics courses* Research in chosen area of chemistry, with final written report as senior thesis This course should be elected for two consecutive semesters just preceding graduation For students majoring in chemistry

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*Credit may not be applied toward graduation for more than one of the following pairs or groups of courses: 160 and any other chemistry course; 163, 187, and 177; 164 and 178 (and accompanying labs); 210 and 211; 231 and 331, 332; 312 and 316; 321 and 324; 322 and 325; 231 and B B 221.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

500. **Advanced Inorganic Chemistry.** (2-0) Cr 2 F *Prereq 301* Concepts of structure, bonding, and chemical reactivity applied to inorganic compounds of the metallic and nonmetallic elements For students not majoring in inorganic chemistry

501. **Inorganic Preparations.** (0-4) Cr 1 F *Prereq 301* Preparation and characterization of inorganic and organometallic compounds by modern research techniques

504. **Organometallic Chemistry of the Transition Metals.** (2-0) Cr 2 Alt. S. *Prereq 301, 332* Transition metal complexes of ligands such as cyclopentadienyl, olefins, acetylenes, benzenes, and carbon monoxide Homogeneous catalysis

505. **Physical Inorganic Chemistry.** (3-0) Cr 3. F *Prereq 301 and 325 or 322.* Elementary group theory and molecular orbital theory applied to inorganic

chemistry Spectroscopic methods of characterization of inorganic compounds

506. Systematic Inorganic Chemistry. (3-0) Cr 3 S *Prereq 301 or 500 and 325* Descriptive chemistry of the metallic and nonmetallic elements

509. Introduction to Inorganic Chemistry Research. (1-0) Cr R F Discussion of the various areas of current research in inorganic chemistry at Iowa State University

510. Advanced Survey of Analytical Chemistry (2-0) Cr 2 F *Prereq. 316.* Selected topics in modern quantitative analysis including analytical separations, titrimetry, spectroscopy, and other instrumental methods

511. Advanced Quantitative Analysis. (3-0) Cr 3 S *Prereq 316.* General methods of quantitative inorganic and organic analysis Aqueous and nonaqueous titrimetry; selective reagents, sampling and sample dissolution, and analytical literature

512. Electrochemical Methods of Analysis. (3-0) Cr 3 F *Prereq: 316, 325 and 325L* Principles of convective-diffusional mass transport in electroanalysis Applications of potentiometry, voltammetry, and coulometry Introduction to heterogeneous and homogeneous kinetics in electroanalysis Analog and digital circuitry Interfacing

513. Analytical Molecular and Atomic Spectroscopy (3-0) Cr 3 S *Prereq 316, 325, 325L* Introduction to physical optics and design of photometric instruments Principles of absorption, emission, and fluorescence spectroscopy Error and precision of optical methods Ultraviolet, visible, and infrared methods of qualitative and quantitative organic and inorganic analysis

516. Analytical Separations. (2-0) Cr 2 F *Prereq 316, 325, 325L* Principles and examples of inorganic and organic separation methods applied to analytical chemistry Solvent extraction, volatilization, ion exchange, liquid and gas chromatography

518. Advanced Quantitative Laboratory. (1-6) Cr 3 S *Prereq 512, 513 and 516* Instrumental methods of qualitative and quantitative chemical analysis

520 Advanced Physical Chemistry. (2-0) Cr 2 S *Prereq 322 or 325* Principles of physical chemistry as they apply to analytical, inorganic, and organic chemistry, including thermodynamics, kinetics, quantum mechanics and spectroscopy For students not majoring in physical chemistry

521 Statistical Thermodynamics. (3-0) Cr 3 F *Prereq 322 or 325* Boltzmann distribution, thermodynamics from a statistical viewpoint, thermodynamic functions of monatomic and polyatomic gaseous molecules. Einstein and Debye crystals

522 Molecular Structure and Bonding (3-0) Cr 3 S *Prereq Phys 447* Quantum mechanical variation principle Molecular and atomic orbitals as function spaces Chemical binding in H_2 Many-electron quantum mechanics Anti-symmetry and determinantal electronic wave functions Self-consistent-field approximation Group theory in quantum chemistry Angular momenta in atoms Orbitals and states in many-electron atoms Electronic structure of small molecules Localization and electronic populations Approximate self-consistent-field methods and semi-empirical treatments of large molecules

523. Chemical Spectroscopy and Structure. (3-0) Cr 3 F *Prereq. 505 or 523, Phys 447.* Maxwell's field equations, interaction of electromagnetic radiation with matter including induced absorption and emission and spontaneous emission, microwave, infrared, Raman and electronic molecular spectroscopy, spectral lineshapes, introduction to solid state symmetry and structure

524. Chemical Thermodynamics (3-0) Cr 3 S *Prereq 322 or 325* The laws of thermodynamics and their applications to single and multi-component systems, heterogeneous and homogeneous equilibria, properties of gases, condensed phases, solutions, and surfaces

525. Diffraction and Crystal Structure. (3-0) Cr 3 Alt S offered 1982 *Prereq. 322 or 325* X-ray neutron and electron diffraction scattering by electrons, atoms, and molecules Data collection techniques, space group symmetry, application of Fourier methods, methods of phasing structural amplitudes.

526. Radiochemistry. (3-0) Cr 3 Alt S, offered 1982 *Prereq 322 or 325.* Radioactivity, preparation and decay properties of radioactive nuclides, interaction of radiation and matter, chemistry of nuclear fission, instrumentation for measuring radioactivity, application of radioactivity to chemistry, especially to analysis

527. Surface Chemistry. (3-0) Cr 3 Alt F, offered 1982 *Prereq 322 or 325* Basic principles and applications

528. Chemical Kinetics and Mechanisms. (2-0) Cr 2 S *Prereq 322 or 325* Methods of studying reaction rates and mechanisms, inference of mechanisms from rate laws, reversible, consecutive, and competing reactions, chain mechanisms, exchange reactions, isotope rate effects, very rapid reactions, acid-base catalysis, theories of unimolecular reactions, absolute rate theory

529. Introduction to Research in Physical Chemistry. (1-0) Cr R F Introduction to the various areas of research in physical chemistry at Iowa State University

530. Advanced Organic Chemistry. (2-0) Cr 2 S *Prereq 332* Selected topics in modern organic chemistry, including structure, reaction mechanisms, organic synthesis and spectroscopy For students not majoring in organic chemistry

531. Physical Organic Chemistry. (2-0) Cr 2 F *Prereq 332* Molecular structure, stereochemistry, kinetics, linear free energy relationships, introduction to reaction mechanisms, nucleophilic and electrophilic substitution reactions

532. Spectrometric Identification of Organic Compounds. (1-3) Cr 2 F *Prereq 332* Principles of infrared, ultraviolet, nuclear magnetic resonance and mass spectroscopy as applied to organic chemistry

533. Physical Organic Chemistry. (2-0) Cr 2 S *Prereq 531.* Survey of reactive intermediates including carbonium ions, carbanions, carbenes and free radicals

534 Modern Organic Synthetic Methods. (2-0) Cr 2 S *Prereq 332* A survey of modern organic functional group transformations

535. Physical Organic Chemistry. (2-0) Cr 2 F *Prereq 533* Molecular orbital theory, molecular rearrangements, orbital symmetry, photochemistry and aromaticity

536. Advanced Organic Synthesis. (2-0) Cr 2 F *Prereq 534* Synthesis of complex organic molecules and natural products

570 (470 DL) Structure and Bonding (2-0) Cr 2 F *Prereq 325* Graduate study in conjunction with 470 Not available for credit for students who have taken 470

599 Nonthesis Research Cr arr *Prereq Permission of staff member concerned*

Courses for Graduate Students, major or minor

600. Seminar in Inorganic Chemistry (1-0) Cr 1 each time taken F S *Prereq Permission of instructor*

601 Selected Topics in Inorganic Chemistry (2-0) Cr 2 each time taken F S *Prereq Permission of instructor* Topics such as chemical applications of group theory, molecular structure and bonding, organometallic compounds, physical techniques of structure determination, nonaqueous solutions, ligand field theory, solid state chemistry, and bio-inorganic chemistry

611 Seminar in Analytical Chemistry. (1-0) Cr 1 each time taken F S

617 Mass Spectrometry. (2-0) Cr 2 Alt S, offered 1982 *Prereq Permission of instructor* Basic physics, instrumentation, and chemical applications of mass spectrometry

620 Seminar in Physical Chemistry (1-0) Cr 1 each time taken S *Prereq Permission of instructor*

621 Statistical Mechanics. (3-0) Cr 3 each time taken Offered every third year, starting 1983 S *Prereq Permission of instructor* Review of classical and quantum mechanics, principles of statistical mechanics applications to thermodynamics and other related problems

622. Quantum Chemistry. (3-0) Cr 3 each time taken Offered every third year starting 1982 F *Prereq Permission of instructor* Construction of general electronic wavefunctions in many-electron systems. Spin eigenstates and spin adapted antisymmetric wavefunctions Energy matrices and density matrices for general electronic wavefunctions Natural and localized orbitals Analysis of the self-consistent-field approximation Discussion of various approaches to the correlation problem, configuration interaction method, pair theories, multi-configuration-self-consistent-field methods Representative applications to atoms, molecules, and reactions

623. Molecular Dynamics. (3-0) Cr 3, each time taken Offered every third year, starting 1981 F *Prereq Permission of instructor* Phenomenological kinetics Classical, semiclassical and quantum scattering theory (with emphasis on elastic scattering) Classical trajectories Energy transfer collisions Unimolecular kinetics Reactive scattering Experimental methods in molecular reaction dynamics

624. Dynamics of Spectroscopic Transitions. (3-0) Cr 3 each time taken Offered every three years starting 1981, S *Prereq Permission of instructor* Photophysical and photochemical relaxation process of molecular states and their implications for spectroscopic transitions

625. Special Topics in Physical Chemistry (2-0 or 3-0) Cr 2 or 3 each time taken F S *Prereq Permission of instructor* Topics such as atomic and molecular structure, surface chemistry, magnetic resonance, solid state spectroscopy, and chemical kinetics

631. Seminar in Organic Chemistry. (1-0) Cr 1 each time taken F S *Prereq 531, permission of instructor*

632 Selected Topics in Organic Chemistry (1-0) Cr 1 each time taken F S *Prereq. 531* Topics of current interest in organic chemistry such as spectroscopy physical organic chemistry, photochemistry, organometallic chemistry, mechanisms of oxidations and reductions, modern organic synthesis, reactive intermediates, heterocycles, and biosynthesis

699. Research. *Prereq Permission of staff member concerned*

Child Development

Samuel G Clark, Head of Department

Professors: Clark, Coulson, Pease, Stockdale

Emeritus Professor: Sunderlin

Associate Professors: Crase, Draper, Engel, Galejs, Lempers, Madera-Miller

Assistant Professors: Culler, Dixon, Fuqua, Glass, Graham, Hegland, Herwig, Jones, Karas King, Petersen, Pinsky, Ragain, Rosauer, Shaw

Instructors: Henry, M J Jacobson, S A Jacobson, Morain, Weigel

Undergraduate Study

For undergraduate curriculum in child development, leading to the degree Bachelor of Science, see *Home Economics, Curricula*

The department offers work for the degree Bachelor of Science with curricula in (1) teaching prekindergarten-kindergarten children (2) child, parent, and community services, and (3) growth and development of children Students in the teaching prekindergarten-kindergarten children curriculum receive certification in prekindergarten-kindergarten teaching and, if additional work is completed, receive approval to teach preschool handicapped children Sophomores selecting the teaching prekindergarten-kindergarten children curriculum must apply to and be accepted in the teacher education program

Child development is the systematic study of how children grow and develop. Opportunities are provided to observe and work with infants, preschoolers, and school-age children Students in these curricula prepare for professional work with children and families in connection with nursery schools, kindergartens, day care centers, hospital programs, welfare agencies, programs for handicapped children, special programs for disadvantaged groups, parent education, 4-H and Youth Services, and

Extension programs. Students preparing for graduate work may elect appropriate courses

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with a major in child development, and a minor for students taking major work in other departments

In addition to fulfilling graduate college admission requirements, applicants should have substantial background in one of the following fields child development, family relations, human biology, human nutrition, education, anthropology, psychology, or sociology Emphasis areas within the department program may include growth and development of children, research and teaching in child development, parent-child relationships, and early childhood programs

There is no uniform foreign language requirement for the degree Master of Science or Doctor of Philosophy. In individual cases, however, competence in one or more languages may be specified by the student's program of study committee

Open to graduate students for minor credit only 342, 443, 455

Courses Primarily for Undergraduate Students

129 Introduction to Child Development. (2-2) Cr 3 F S SS Emphasis on physical/motor, social/emotional, and intellectual development of children as influenced by family, education, and society Directed observation of children

201 Family Life Development. (F E 201) (3-0) Cr 3 F S SS A study of the dynamic processes of co-development of families and individuals, both normal and exceptional Patterns of self-development and life-span development with focus on the interaction between and among individuals

224 Development and Guidance in Infancy. (3-0) Cr 3 F S *Prereq 129 or Psych 230* Developmental characteristics of infants from the prenatal period through two years of age Implications for guidance of infants and toddlers within family and group care settings Participation with infants

225 Development and Guidance in Early Childhood. (2-2) Cr 3 F S SS *Prereq 129 or Psych 230* Developmental characteristics of children from 2 to 6 years of age with implications for individual guidance within family and group care settings Observation and participation with preschool and kindergarten children

226. Development and Guidance in Middle Childhood (El Ed 226) (2-2) Cr 3 F.S.SS *Prereq 129 or Psych 230* Developmental characteristics of children from 5 to 12 years of age with implications for guidance Observation and participation with children

240. Literature for children. (El Ed 240) (3-0) Cr 3 F S SS *Prereq 129 or Psych 230* Evaluation of literature for children Roles of literature in the total development of children Literature selection and use Participation with children

318. Study Tour. Cr 5 F.S *Prereq 224 or 225 or 226; junior classification* Study of and visits to child and family centers, institutions, and agencies that serve people in various socio-economic and ethnic groups and the handicapped Fee.

341 Activities and Materials for Children. (3-2) Cr 4 F S SS *Prereq. 224 or 225 or 226* Theories and principles underlying the selection of activities and materials for individuals and groups of children, infancy through middle childhood. Participation with children

342. Guidance of Children: Theories and Practices. (El Ed 342) (2-2) Cr 3. F.S. *Prereq: 225, 226.* Behaviors of children in group situations. Basic theories of guidance applicable to children including the exceptional child Principles and techniques for guidance of children Participation with children in groups

355. Young Children with Handicaps. (3-0) Cr 3. F S. *Prereq: 224, 225.* Characteristics of children from infancy through 5 years of age with physical, motor, communicative, cognitive, social, emotional, and behavioral exceptionalities. Interactions of impairments and experiences in affecting total development Effects on family and community

369. Research and Assessment in Child Development. (3-0) Cr 3 F S *Prereq 224 or 225 or 226* Processes of generating a body of knowledge through application of the scientific method Readings in child development research Considerations for interpreting child development research findings Review and use of assessment tools for appraising the performance of children including the exceptional child

443. Curriculum Planning for Children. (3-0) Cr 3 F S *Prereq 341* Examination, evaluation, and development of curricula for children Principles and techniques involved in planning programs for children

445. Administration of Programs for Children. (3-0) Cr 3 F S *Prereq 341* Principles and techniques involved in financing and managing programs for children

449. Parent-Professional-Community Relations. (3-0) Cr 3 F S *Prereq 224 or 225 or 226* Interrelationships among child development professionals and parents and other family members, and personnel working toward an optimal environment for children Strategies for parent involvement including families with exceptional children

417A. Supervised Teaching in Prekindergarten-Kindergarten. Cr 6 F S SS *Prereq 443 Classification in 417B or 417C, full admission to teacher education program Reservation required* Teaching experience with prekindergarten or kindergarten children

417B. Supervised Teaching in Child Centers. Cr 6 F S SS *Prereq 443 or 445 Reservation required* Teaching experience in a center for children

417C Supervised Teaching in Programs for Handicapped Children. *Cr 6 F S SS Prereq 455 Classification in 417A, full admission to teacher education program Reservation required* Teaching experience with preschool handicapped children

418. Practicum Cr arr F S SS *Prereq 224 or 225 or 226 Reservation required* Supervised work in specialized programs related to child development

455. Programming for Children with Handicaps. (2-2) Cr 3 S *Prereq 355, 369, 443* Development of individualized, assessment-based programs for handicapped children Methods for adapting materials, activities, and guidance Participation with handicapped children

490. Independent Study Cr arr *Prereq 6 credits in child development* Consult department office for procedure
A Child Development
B Nursery Education
C Community Services
F Field experience
H Honors
R Research

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

524. Principles and Theories of Child Development. (3-0) Cr 3 F S SS *Prereq 6 credits in child development or psychology.* Historical and theoretical foundations of child development Developmental approach to the study of child behavior Basic principles, major theories, and research Observation of children

525. History and Theories of Early Childhood Education. (3-0) Cr 3 F *Prereq 524 or 6 credits in child development or psychology* History, theories, and trends in early education Role of early education, including intervention models, in the total educational system

541. Giftedness in Children. (3-0) Cr 3. Alt F, offered 1981, Alt SS , offered 1983. *Prereq. 524 or 6 credits in child development or psychology.* History and theories of creative and intellectual giftedness Characteristics of children with superior abilities. Assessment, current research, family and educational issues.

543. Developmental Disabilities in Children. (3-0) Cr 3 F Alt. SS., offered 1982 *Prereq: 524 or 6 credits in child development or psychology.* Characteristics of children with developmental disabilities: mental retardation, cerebral palsy, epilepsy, autism, and some forms of dyslexia. Consideration of cultural, familial, and educational influences and legal implications. Research on behavioral characteristics associated with developmental disabilities in childhood.

545. Planning and Administration of Programs for Children. (3-0) Cr. 3 S. Alt. SS., offered 1983. *Prereq: 525.* Objectives, procedures and research relevant to the administration and development of programs for children

548. Parent-Child Relations and Parent Education. (3-0) Cr 3. F Alt. SS , offered 1982 *Prereq: 524 or 6 credits in child development or psychology.* Analysis of theories and research applicable to parent-child interactions, role of the parent as a socializing agent Principles, procedures, current models and evaluation of parent education programs.

549. Child Rearing Practices Within and Across Cultures. (3-0) Cr 3 S Alt. SS., offered 1983. *Prereq: 524 or F E 575, or 6 credits in anthropology.* Analysis of child-rearing practices and life styles of subcultures within the United States and a variety of other cultures. An examination of current research on the child from a cultural perspective

566. Research Methods in Child Development. (3-0) Cr 3 S *Prereq 524, credit or classification in Stat 401.* Introduction to concepts, strategies, and methods of developmental research and assessment of children Application of selected research strategies to current child development research. Experience in assessment procedures, methods of data collection, analysis, interpretation, and dissemination of findings.

590. Special Topics. Cr arr. *Prereq: 6 credits in child development*
A Developmental Processes
B Early Childhood Education.
C Community Services and Programs
D Research
E Professional Relations
F Program Administration
G College Teaching

Courses for Graduate Students, major or minor

616. Seminar. Cr arr F.S
A Current Issues in Child Care
B Developmental Processes in Children
C Developmental Appraisal of Children
D Exceptional Children
E Guidance of Children
F Prenatal and Infant Development
G Parent and Family Issues
H Research Issues in Child Development
I Eminent Persons in Child Development

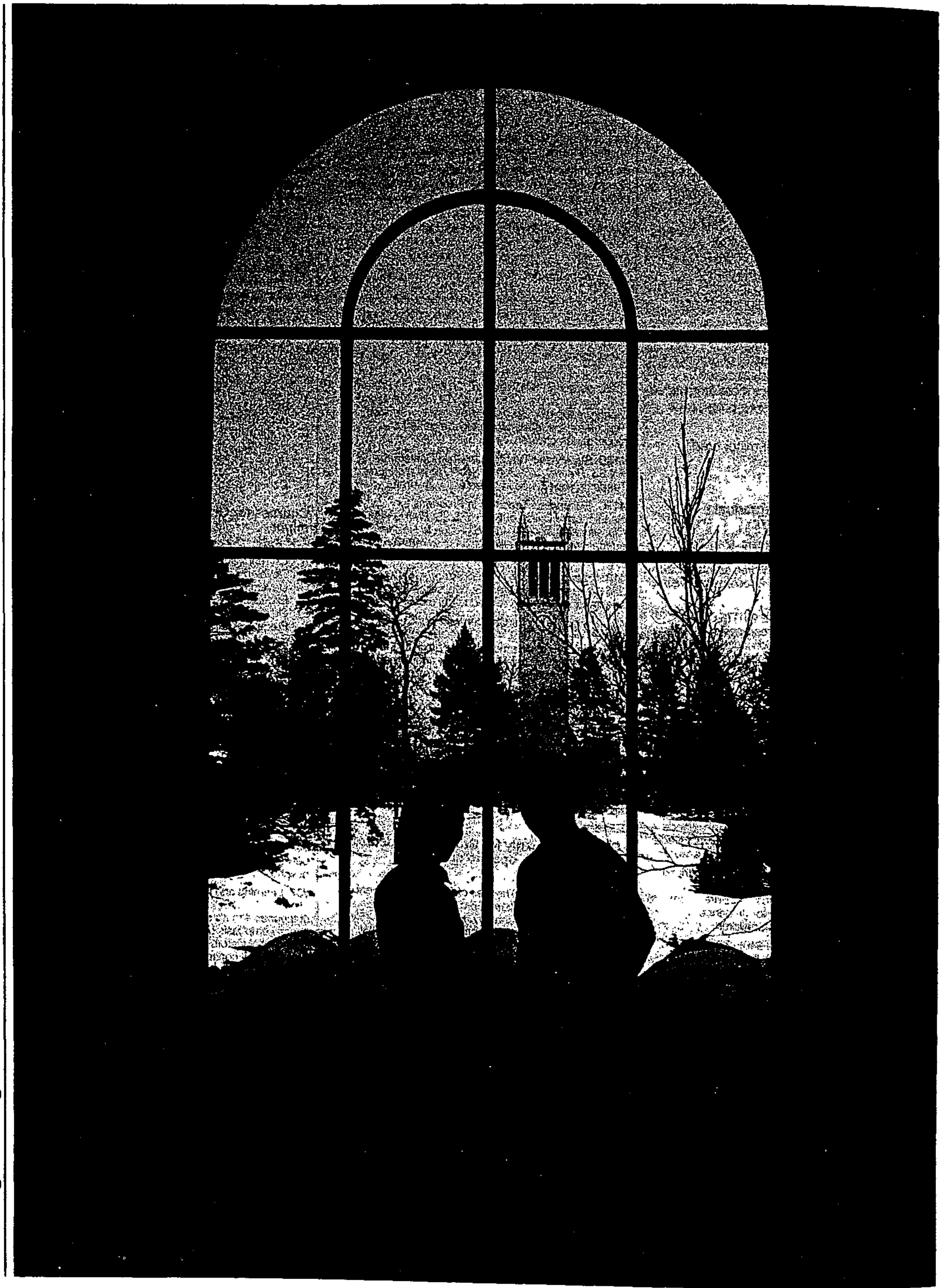
630. Physical and Motor Development in Children. (3-0) Cr 3 Alt F , offered 1982. *Prereq: 524.* Development of selected aspects of the structure and function of body systems in infants and children. Relationships of developing motor abilities to behavior Identification and evaluation of theories, research, and assessments of physical development and motor performance.

631. Cognitive and Language Development in Children. (3-0) Cr 3 Alt. S., offered 1982. *Prereq: 524.* Theories of and empirical findings in the development of thinking and intelligence Theories of language acquisition; research on syntactic and semantic development. Consideration of issues concerning interrelationships between cognitive development and developmental psycholinguistics.

632. Learning and Perceptual Development in Children. (3-0) Cr 3 Alt S , offered 1983. *Prereq: 524.* Appraisal of theories and models of perceptual development with special emphasis on the role of innate versus experiential factors and on cross-modal perception. Fundamental concepts and principles of the development of learning. Consideration of issues concerning the role of perceptual factors in learning processes.

633. Social and Emotional Development in Children. (3-0) Cr 3. Alt. F , offered 1981 *Prereq: 524.* Consideration of theoretical and research contributions to the understanding of children's social and emotional development. Socialization processes and personality development.

699. Research.



Civil Engineering

Carl E Ekberg, Jr , Head of Department

Professors: Austin, Baumann, Brewer, Carstens, Cleasby, Demirel, Dougal, Ekberg, Handy, Hardy, Hoover, Jellinger, Jeyapalan, Klaiber, Lee, Lohnes, Mashaw, Mickle, Morgan, Oulman, Patterson, Ring, Sanders, Spangler, Young

Emeritus Professor: Lubsen

Associate Professors: Fung, Girton, Greimann, Kannel, Porter, Russo, Sheeler, Ward

Assistant Professors: Chase, Dunker, Hastings, Montag, Pitt, Ranch, Ringwald, Rossmiller, Wolde-Tinsae

Instructor: Day, Dickenson

Undergraduate Study

For undergraduate curriculum in civil engineering leading to the degree Bachelor of Science, see *College of Engineering, Curricula.*

Civil engineering consists of the economic application of the laws, forces, and materials of nature to the planning, design, construction, maintenance, and operation of public and private facilities Commonly included are transportation systems, bridges and buildings, water supply, pollution control, irrigation, and drainage systems, river and harbor improvements, dams and reservoirs Civil engineering also includes the planning, design, and responsible execution of surveying operations, and the location, delimitation, and delineation of physical and cultural features on the surface of the earth. Research, testing, sales, management, and related functions are also a part of civil engineering Work on the campus is supplemented by inspection trips which furnish an opportunity for firsthand study of engineering systems in operation, as well as projects under construction

Graduate Study

The department offers work for the degree Master of Science with majors in civil, geotechnical, municipal, sanitary, structural, and transportation engineering, and in geodesy and photogrammetry, for the degree Doctor of Philosophy with majors in transportation, structural, sanitary and geotechnical engineering, and minor work to students taking major work in other departments

Candidates for the degree Master of Science are required to satisfactorily complete 30 credits of acceptable graduate work, including preparation of a thesis or the completion of an engineering report in lieu of a thesis

The department strongly recommends that all candidates for the degree Doctor of Philosophy demonstrate a significant level of proficiency in one of the following languages French, German, Russian, or Spanish However, with the approval of a doctoral candidate's program of study committee, 6 additional credits of course work outside the Department of Civil Engineering may be substituted for a language requirement

The normal prerequisite to major graduate work is the completion of a curriculum substantially equivalent to that required of engineering students at this University However, because of the diversity of interests within the graduate programs in civil engineering, a student may qualify for graduate study even though undergraduate or prior graduate training has been in a discipline other than engineering Supporting work will be required depending upon the student's background and area of interest A prospective graduate student is urged to specify the degree program in which he or she is interested on the application for admission

The department participates in the interdepartmental minor program in Energy Systems Engineering and in the interdepartmental programs in Technology and Social Change, Transportation Planning, and Water Resources (See Index)

Open to graduate students for minor graduate credit only 315, 317, 332, 333, 334, 350, 351, 360, 362, 370, 371, 412, 414, 417, 418, 419, 426, 446, 450, 451, 452, 460, 472, 485, 486

Courses Primarily for Undergraduate Students

100. Technical Lecture. (1-0) Cr R F Discussion of various phases of civil engineering For transfer students only Evaluation of transfer credits and discussion of graduation requirements

212 Fundamentals of Surveying (2-3) Cr 3 F S *Prereq Math 165 or Math 175* Surveying fundamentals with emphasis on engineering surveys Familiarization with basic instrumentation Field and office procedures for leveling, traversing, and mapping Survey computations, including theory of errors and computer applications Introduction to photogrammetry and its application to surveying and mapping

213. Advanced Engineering Surveying (1-6) Cr 3 F S *Prereq 212, Com S* 172, Stat 105 Introduction to precise control surveys, including triangulation, adjustments and state plane coordinate systems Public land subdivision system and property surveying requirements Surveying aspects of highway curves and earthwork computations Introduction to engineering astronomy Computer application

215, 215A. Engineering and Construction Surveying (1-3) Cr 2 F S *Prereq Competence in algebra and trigonometry* Surveying fundamentals with emphasis on engineering and construction Familiarization with basic instrumentation Field and office procedures for leveling, traversing, and construction surveying Survey computations Introduction to highway and earthwork surveying and computations Techniques of construction jobsite surveying 215A Primarily for students in the College of Agriculture and College of Design

295 The Practice of Engineering in Government. (1-0) Cr 1 F Practice of civil engineering in various agencies of government Agencies and their responsibilities Continuing education, professional ethics, and personnel recruitment Various civil engineering projects presented, discussed, and visited Fee for field trip

296. The Private Practice of Engineering. (1-0) Cr 1 S Private practice of civil engineering for the general public Opportunities and responsibilities Continuing education, professional ethics, and personnel recruitment Various civil engineering projects presented, discussed and visited Fee for field trip

298, 398, 498. Cooperative Education. Required of all cooperative students *Prereq. Permission of department head* 298 Work periods for students with sophomore standing in a regularly established program 398 Work periods for juniors 498 Work periods for seniors Students must register for these courses prior to commencing each work period

301. Cartography. (Geog 301) *See Earth Sciences*

315. Geodetic Control Systems. (1-3) Cr 2 F *Prereq. 213* Familianzation with geodetic instrumentation theodolites, automatic levels, electronic distance measuring equipment, and accessories Theory of geodetic control systems Design of control networks, such as triangulation, trilateration, and leveling Specifications for first, second, and third order systems Introduction to adjustments.

317. Land Surveying. (1-3) Cr 2 S *Prereq. 213* Review of public land survey systems. Modern land data systems Field and problem work embraces the complete resurvey of a land parcel, including record search, preparation of plat and legal description Case studies Legal aspects

328 Sanitary Engineering in Environmental Control (2-0) Cr 2 F *Prereq. Phys 111 or 221* Review of engineering approaches to protecting public health through water and wastewater treatment, air pollution control, and solid wastes management Organization, administration, and operation of regulatory agencies Not available for graduation credit for students in civil engineering

332. Structural Analysis I (2-2) Cr 3 F S *Prereq E M 324* Shear and moment diagrams Unit load method Moment distribution Approximate methods Influence lines

333. Structural Steel and Timber Design I. (2-2) Cr 3 F S *Prereq 332, E M* 327 Design and behavior of the elements of steel and timber structures, proportioning members and connections Introduction to plastic design, composite design, and building and bridge loadings and design

334 Reinforced Concrete Design I. (2-2) Cr 3 F S SS *Prereq 332, E M 327* Analysis and design of beams, one-way slabs, and columns Preliminary design of building frames using pattern loading and moment coefficients

336. Structures for Architects I. (3-2) Cr 4 F S SS *Prereq 4 credits in engineering mechanics* Calculation of reactions, shear and moment diagrams Truss analysis Unit load method of deflection and rotation determination Preliminary design of statically determinate beams and columns in timber and steel Introduction to structural systems, wood, masonry, steel and concrete structures Primarily for students in architecture

350. Introduction to Transportation Planning. (3-0) Cr 3 F S SS *Prereq 3 credits in statistics, junior classification* Planning of urban and regional transportation systems Applications of population, land use, economic, social, and travel studies to problems of transportation system configuration and route location Organization and coordination of the transportation planning function Not available for graduation credit for students in civil engineering

351 Introduction to Transportation Engineering. (2-3) Cr 3 F S SS *Prereq 213, Phys 221, Stat 105* Introduction to planning and design of highway, air, rail, water, and pipeline transportation facilities Technological and economic factors Transportation terminals Suggested for engineering students only

360 Soil Engineering. (2-6) Cr 4 F S *Prereq Geol 301, credit or classification in E M 324* Introduction to basic soil engineering and testing Identification and classification tests, soil structure, soil mineralogy, soil water, systems, and interactive forces, aggregate gradation, absorption and blending, principles of settlement, soil bearing values, shearing stresses in soils and shear strength testing, application of soil engineering in subgrades, embankments, retaining walls, foundations, piles, and underground conduits

362. Design of Concretes and Pavements. (0-6) Cr 2 F S *Prereq 360* Physical and chemical properties of bituminous, portland, and other cements, mix design and testing of concretes, admixtures, mixing, handling, placing and curing, pavement thickness design

370 Hydrology (2-0) Cr 2 S *Prereq Phys 111 or 221* Introduction to hydrology and water resources including water sources, distribution, rainfall-runoff relations, streamflow, beneficial uses of water, and water requirements For non-engineering majors

371. Engineering Hydrology. (2-3) Cr 3, F,S SS. *Prereq. E M 378, Com S 172.* Elements of engineering hydrology, precipitation, infiltration, direct runoff, evapotranspiration, groundwater and streamflow; full pipe flow, open channel hydraulics, storm water collection, applications to engineering problems

412. Survey Computation and Design. (2-0) Cr 2 S *Prereq 315* Error theory, adjustment theory, and least squares applied to geodetic control systems Survey design principles derived from error propagation theory Relationship to development of surveying control specifications

414. General Photogrammetry and Photo-Interpretation. (For 414) *See Forestry*

417. Subdivision Design and Layout. (2-2) Cr 3 F *Prereq 213, 371* Planning of residential subdivisions according to topography and specifications Zoning and subdivision ordinances and platting laws. Surveying and engineering design computations.

418. Stereo-Photogrammetry. (2-3) Cr. 3. F *Prereq: 414 or For 445* Photogrammetric optics. Calibration. Geometry of aerial photos. Rectification. Stereo-plotter theory: paper print, projection-type and advanced. Comparators. Practice with projection-type plotter

Project planning and design of photogrammetric systems to achieve national map accuracy standards.

419. Principles and Techniques of Remote Sensing. (Aer E 419) See *Aerospace Engineering.*

426. Municipal Water and Wastewater Engineering. (2-4) Cr 4. F S *Prereq: 371, Chem 167* Potable water quality and quantity objectives, water sources and treatment methods, water pollution control objectives and treatment methods Pumping storage and distribution of water Wastewater quantities and collection systems.

438. Structures for Architects II. (2-2) Cr 3 F S *Prereq 336. Load criteria. Approximate methods of frame analysis* Design and behavior of the elements of steel structural systems Application of current building specifications in the proportioning of members and connections Introduction to plastic design, composite design, building loading and design, and timber design Primarily for students in architecture

439. Structures for Architects III. (2-2) Cr 3 F S SS *Prereq 336* Moment distribution Analysis and design of reinforced concrete beams, one-way slabs, footings, and columns Preliminary design of building frames utilizing moment coefficients Introduction to prestressed concrete and masonry design Primarily for students in architecture

446. Senior Structural Design Projects. (1-4) Cr 3 S *Prereq: 333, 334* Building and bridge design in steel and concrete Application of current building code and design specifications. Preliminary designs will include investigating altemative structural systems and materials. Final designs will include preparation of design calculations and sketches

450. Traffic Engineering. (2-3) Cr 3 F *Prereq 351* Elements of highway and street traffic circulation and planning Driver and vehicle performance Traffic analysis and traffic control Lighting Safety

451. Urban Transportation Planning. (2-3) Cr 3 S *Prereq 350 or 351.* Planning of highway systems and terminals as part of a complete planning approach, public transportation planning, transportation planning studies, projections, analysis, plan formulation, and programming

452. Highway Design. (2-3) Cr 3 F S SS *Prereq 351, 362, 371* Design, construction, and maintenance of highway facilities, earthwork, drainage structures, pavements Preparation of environmental impact statement A complete design project is required

460. Foundations. (3-0) Cr 3 F S *Prereq 360* Fundamentals of foundation engineering Exploration and site evaluation Determination of allowable soil pressure Selection of type, configuration of and structural design of foundations on sand, silt, and clay

472. Applied Hydraulic Design. (2-3) Cr 3 S *Prereq 371* Charateristics of flow in natural and constructed channels, hydraulic design of culverts, bridge waterway openings, spillways, hydraulic gates and gated structures, pumping stations, and miscellaneous water control structures; flow measuring devices

485. Engineering Construction. (2-2) Cr 3 F S *Prereq Classification in 332, E M 327* Construction contracts, competitive bidding procedures, cost estimating, construction planning and scheduling for civil engineering projects The critical path methods, equipment selection and production capabilities, falsework and concrete form work and cofferdam designs are covered

486. Civil Engineering Specifications. (2-0) Cr 2 S *Prereq: Stat 105, credit or classification in Mgmt 315 or I E 480.* Contract documents, competitive bidding procedures for public work projects. Negotiated contracts for engineering design services. Preparation and interpretation of specifications for civil engineering projects.

490. Independent Study. By conference Cr 1 to 6. F S. *Prereq: Permission of instructor* Independent study in any phase of civil engineering Preclassification contract required. H Honors.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates*

505. Public Works Engineering. (3-0) Cr 3 Alt. S., offered 1983. *Prereq: 426, 452* The civil engineer's role in the public works field; municipal engineering and public works responsibilities in planning, financing, and in administering design, construction, operation, and maintenance of public facilities

510. Analytical Photogrammetry. (2-0) Cr 2 S *Prereq. 513, 418 or For 445.* Concepts, principles, and methods of analytical photogrammetry Coordinate transformation Colinearity, coplanarity, and scale restraint conditions Linearization of systems of equations Computational methods. Adjustment of strips and blocks Analytical plotters.

512. Geodetic Astronomy. (1-3) Cr 2 F *Prereq 315, Math 265 or 275* Celestial sphere and terrestrial coordinate systems. Coordinate transformations Theory of precise determinations of latitude, longitude, azimuth, and time Astronomical and instrumental corrections

513. Adjustment of Observations. (2-0) Cr 2 F *Prereq 315, 414, Stat 105* Theory of errors Error propagation in geodetic and photogrammetric systems Observation and condition equations Practice in the application of theory of least squares to adjustment of observations Error analyses

514. Fundamentals of Geodesy. (2-0) Cr 2 F *Prereq 213 or Geol 302A.* General theory of geometric and physical geodesy Applications of geodesy to scientific and engineering problems Size and shape of the earth Geometry of geodetic reference surfaces

515. Physical Geodesy. (2-0) Cr 2 S *Prereq 514, Math 266.* Gravity and potential theory Geoid and other equipotential surfaces Theory of geoidal undulations and deflections of the vertical Isostasy Gravity instrumentation and data reduction Spherical harmonic and related analyses

519. Remote Sensing of Earth Resources and the Environment. (1-3) Cr 2 F *Prereq. 419* Review of the the theoretical basis of remote sensing, including photogrammetry and photo-interpretation Remote sensing systems, including multispectral cameras, thermal mappers, multispectral scanners, microwave and radar imagers Applications of remote sensing to resources, environment, and land use

520. Fundamentals of Analysis and Treatment of Water (2-3) Cr 3 F *Prereq 426, Chem 211.* Physical and chemical processes in the analysis and treatment of water; includes adsorption, ion exchange, membrane processes, chemical precipitation, and gas transfer

521. Fundamentals of Analysis and Treatment of Wastewater. (2-3) Cr 3 S *Prereq 426, Chem 231, Micro 300* Charactenzation of wastewaters relative to their treatability and selection of appropriate processes for their treatment

522. Water Pollution Control Plant Design. (1-3) Cr 2 S *Prereq C E 426, Chem 231, Biol 101* Principles and design of physical, chemical and biological treatment processes, plant layout and hydraulic considerations

523. Water Treatment Plant Design. (1-3) Cr 2 F *Prereq: 426, Chem 211* Principles and design of conventional water treatment processes including coagulation, flocculation, sedimentation, filtration, disinfection and corrosion control Plant layout and hydraulic considerations

524. Solid and Hazardous Waste Collection and Disposal. (2-0) Cr 2 Alt S, offered 1982 *Prereq 371, 360* Planning design and operation of solid and hazardous waste collections and disposal facilities including resource recovery and waste-to-energy systems.

531. Structural Analysis by Finite Elements. (3-0) Cr 3. S *Prereq: 533* Use of the finite element method for the analysis of complex structural configurations. Plane stress, plate and shell finite elements General purpose finite element programs Newmark methods.

533. Structural Analysis by Matrix Methods. (3-0) Cr 3 F *Prereq: 332* Analysis of structural problems by means of matrix formulation Stiffness and flexibility methods Direct stiffness method for 2-D frames, grids, 3-D frames General purpose frame programs

534. Classical Analysis Methods. (3-0) Cr. 3. F *Prereq. 332.* Basic structural principles. Moment area, energy methods, unit load method, conjugate beam. Extensions to slope deflection and moment distribution. Non-prismatic members, temperature changes, axial load effects.

537. Dynamic Analysis of Structures. (3-0) Cr 3. S *Prereq. 533, E M 345.* Single and multi-degree of freedom systems. Free and forced vibrations. Linear and nonlinear response Modal analysis Response spectra. Computer programs for dynamic analysis. Seismic design.

539. Prestressed Concrete Structures. (3-0) Cr 3. Alt. F, offered 1981 *Prereq: 334.* Principles of prestressed concrete with applications to structural design

540. Behavior of Reinforced Concrete Structures. (3-0) Cr 3 Alt F, offered 1982 *Prereq 334* Behavior and strength of reinforced concrete members by reviews of experimental and analytical investigations, flexure, axial load, shear, bond, torsion, combined loadings

544. Limit Analysis and Design. (3-0) Cr 3 S *Prereq 333, 334.* Plastic analysis and design of steel beams and frames. Limit analysis and design for reinforced concrete beam and frame structures Determination of ultimate loads and deflections by mechanism procedures Considerations of hinging, ductility, and minimum weight design

546. Advanced Structural Design in Metals. (3-0) Cr 3 S. *Prereq: 333* Design of built-up beams, plate girders and heavy connections Study of the theories of analysis of the behavior of structural metal members and the interpretation of specifications for the design of buildings and bridges

547. Analysis and Design of Plate and Slab Structures (3-0) Cr 3 F *Prereq. 334, E M 514, Math 266* Bending and buckling of thin plate components in structures Slab analysis by finite difference method Analysis of shell roofs by membrane and bending theories

549. Reinforced Concrete Design II. (2-2) Cr 3 F *Prereq. 334* Design of long columns, floor slabs, building frames, and combined footings Design considerations for torsion, biaxial bending, and structural joints Introduction to cold-formed composite slab design and masonry design

550. Advanced Highway Design. (3-3) Cr 4 S *Prereq 452* Rural and urban street and highway design Establishment of design criteria, application to street and highway systems, and to intersections and interchanges, drainage design, urban freeway design aspects Consideration of environmental interrelationships in route location and design

552. Highway and Traffic Safety. (2-2) Cr 3 S *Prereq 351* Engineering aspects of highway traffic safety Reduction of accident incidence and severity through highway design and traffic control Accident analysis Legal implications of safety in highway design, maintenance, and operation

553. Advanced Traffic Engineering. (3-4) Cr 5 F *Prereq 351* Driver, pedestrian and vehicular characteristics Traffic characteristics, highway capacity; traffic studies and analyses Principles of traffic control for improved highway traffic service and safety Traffic signals, signs, and markings, lighting, channelization, other traffic control measures

556. Airport Planning and Design. (2-3) Cr 3 F *Prereq Credit or classification in 452* Airport planning including financing, activity forecasts, site selection, zoning, operation of landing and terminal areas Drainage, geometric and structural design of runways, taxiways, and aprons

557. Transportation Analysis and Forecasting. (2-3) Cr 3 F *Prereq. 451, Stat 331 or 401 or 446* Travel studies and analysis of data. Travel projections Public transportation forecasts and analyses

558. Urban Transportation Development Laboratory (1-2) Cr 2 S *Prereq 350 or 351* Study of designated problems in traffic engineering, urban transportation planning, and urban development. Forecasting and evaluation of social, economic, and environmental impact of proposed solutions; considerations of altematives Formulation of recommendations and presentation in the host community.

560. Soil Mechanics. (3-0) Cr 3 F *Prereq 360* Advanced treatment of theory and principles of engineering soil mechanics as related to permeability, capillarity, seepage forces, stress distribution, effective stresses, consolidation, shear strength, slope stability, earth pressure, bearing capacity, piles, and underground conduits.

562. Airphoto Interpretation of Engineering Soils. (2-3) Cr 3. S. *Prereq: 360, Geol 301 or 302A.* Recognition, identification and mapping of engineering soils from airphotos. Site evaluation; material reconnaissance, principles and applications of infrared, radar, microwave technology; field checking.

563. Advanced Soil Engineering Laboratory. (2-3) Cr 3 S *Prereq 565* Analysis of soils and civil engineering materials by X-ray diffraction, differential thermal, thermogravimetric and electron beam methods.

564. Advanced Soil Engineering Laboratory. (1-6) Cr 3 S. *Prereq: 560.* Triaxial shear, consolidation, permeability, capillary testing and analyses; relation of hydrostatic excess pressures to compositional influences. Field load tests.

565. Soil Behavior. (2-3) Cr. 3. F. *Prereq: 360.* Physico-chemical factors affecting soil stability, clay minerals, clay colloid chemistry and effects of chemical

additives on behavior of soils and particulate systems Determination of colloidal properties such as exchange capacity, zeta potential, capillarity and pore shape and size distribution

567 **Portland Cement Concrete Mixes and Pavements.** (2-3) Cr 3 F *Prereq 362* Effects of cement chemistry and water-cement ratio, curing method, air entrainment, pozzolans, and other admixtures on concrete plasticity, strength and durability Fibrous, light weight and high-density concrete Elements of fatigue and creep Principles of rigid pavement design

568. **Bituminous Materials and Pavements.** (2-3) Cr 3 S *Prereq 362* Effect of chemical, physical and rheological properties of bituminous materials on mix and thickness design of flexible pavement systems. Durability, fatigue, performance evaluation, and rehabilitation of flexible pavements

571 **Surface Water Hydrology.** (2-3) Cr 3 F *Prereq 371* Collection and analysis of hydrologic data concerning precipitation, infiltration, evapotranspiration, direct runoff and streamflow, theory and use of frequence analysis to hydrologic data, deterministic and statistical hydrologic models

572 **Water Resources Systems Engineering.** (3-0) Cr 3 Alt F , offered 1982 *Prereq 371, I E 312* Applications of systems analysis and operations research techniques to the planning, design, and operation of water resources systems, use of linear programming, network analysis, dynamic programming, and simulation as tools in solving water resources problems, use of deterministic and stochastic models in water resources planning and design

573 **Ground Water Hydrology.** (2-3) Cr 3 S *Prereq 371* Ground water as a source of municipal, industrial, and agricultural water supplies, location, occurrence, hydraulics of flow, determination of aquifer and well characteristics, pumping test analysis, well design and pump selection, ground water basin management

574 **Multiple use of Water Resources** (2-0) Cr 2 F *Prereq 371* Social, economic, and technical phases of governmental participation in public works programs in the field of water resources, study of planning and design of multi-purpose water resources projects

577 **Water Resources I** (W Res 577) See *Water Resources*

578 **Water Resources II** (W Res 578) See *Water Resources*

585 **Highway Construction Methods** (2-0) Cr 2 F *Prereq 362, 485* Methods and equipment used in processing materials and constructing highways and their appurtenances, scheduling and controlling operations, compliance with specifications

586. **Heavy Construction Method.** (2-0) Cr 2 S *Prereq 485* Methods and equipment employed in heavy construction including piles, caissons, heavy foundations, piers, cofferdams and river works, heavy concrete structures, retaining walls, tunneling and dam projects

590 **Special Topics.** Cr 1 to 5 each time elected F S Preclassification contract required

*An undergraduate student must have an academic standing in upper one-half of his/her class in order to enroll in any 500-level civil engineering course

Courses for Graduate Students, major or minor

616 **Advanced Topics in Photogrammetry, Remote Sensing, and Image Interpretation.** (2-0) Cr 2 each time taken, maximum 6 credits S *Prereq 510* Study of advanced concepts in photogrammetry, remote sensing, and image interpretation, including satellite applications Projecting systems Advanced topics in data reduction and image processing

618 **Advanced Topics in Geodesy.** (2-0) Cr 2 each time taken, maximum 6 credits S *Prereq 515* Study of advanced concepts in geodesy, including satellite applications Mathematical geodesy, including statistical methods Advanced computational methods

622. **Advanced Topics in Water Pollution Control.** Cr 2 to 4 Alt F , offered 1982 *Prereq 522* Study of advanced concepts in water pollution control Analysis and application of current developments to pollution control methods

623. **Advanced Topics in Water Treatment.** Cr 2 to 4 Alt F , offered 1981 *Prereq 523* Study of advanced concepts in water treatment Analysis and application of current developments to water treatment methods

649. **Advanced Topics in Structural Engineering.** (3-0) Cr 3 F S *Prereq Permission of structural graduate faculty* Advanced concepts in structural engineering topics Emphasis for a particular offering will be selected from the following topics A Behavior of Metal Structures, B Design of Concrete Shells, C Cable-Supported Structures, D Advanced Matrix Analysis of Structures, E Dynamic Design of Structures

656. **Planning Transportation Systems.** (3-0) Cr 3 S *Prereq 557* Statewide, regional, and local transportation system planning Development and calibration of models for travel forecasting Concepts of the comprehensive, cooperative, continuing transportation planning process Corridor travel planning

660. **Foundations and Underground Structures.** (3-0) Cr 3 S *Prereq 560* Advanced foundation analysis and design to meet various soil conditions Review of recent literature Field investigation Case histories Reports

663 **Earth Dams.** (2-0) Cr 2 Alt S , offered 1982 *Prereq 560* Location, selection of materials, design, and construction of earth dams Fee for field trip

665. **Stability of Soils and Granular Materials.** (3-0) Cr 3 Alt S , offered 1983 *Prereq 560, 565* Theoretical soil mechanics and mechanics of particulate media Three dimensional stress space, strains and soil failure theories Granulometry and colloid chemistry as related to soil strength, classification, and stabilization by chemical and physical means

671 **Advanced Topics in Water Resources Engineering** (3-0) Cr 3 Alt F , offered 1981 *Prereq 571, 572* Study of advanced concepts and experimental techniques used in solving water resource engineering problems Application of simulation methods in areas of hydrology, hydraulics of water control

690. **Advanced Topics** Cr 1 to 3 Preclassification contract required

699 **Research**

Classical Studies

Program Committee: J Ruebel, Chair, A Avraamides, K Gwiasda, P Hollenbach, J Leguard

The Classical Studies Program is a cross-disciplinary program in the College of Sciences and Humanities which offers an integrated curriculum of courses in the languages, literatures, history, and thought of ancient Greece and Rome from the time of the Homeric poems to the reign of the Emperor Constantine, while encouraging as well a perspective on the contemporaries of classical culture, such as the Near East, on its antecedents, such as Mycenaean Greece, and on its heirs in the Middle Ages and Renaissance

In addition to fulfilling group requirements and electives for all students, courses in classical studies provide significant background for students whose majors are in anthropology, English, foreign languages and literatures, history, music, philosophy, or related fields

The program committee will assist students interested in planning an individual major or an area of concentration in a distributed studies major For details of the requirements for such majors within the College of Sciences and Humanities, see *Sciences and Humanities Cross-Disciplinary Studies*

Completion of one year of classical Greek or Latin (or the equivalent) is a prerequisite to the minor in classical studies A student who wishes to declare a minor must then complete at least the following requirements. (a) one additional semester of the same classical language; (b) 371, (c) Hist 402 or 403, (d) six additional credits from the primary courses listed below, or as approved by the program committee

Primary Courses

371 **Greek and Roman Mythology.** (3-0) Cr 3 F Survey of the legends, myths, and sagas of the classical world with emphasis on the principal gods, demigods, and heroes, and their implications for ancient social, psychological, and religious attitudes, some attention given to important modern theories

490. **Independent Study.** Cr 1-6 each time taken *Prereq 7 credits in classical studies at the 200 level or higher, permission of the chair of the program committee* Designed to meet the needs of students who wish to study specific topics in classical civilization in areas where courses are not offered, or to pursue such study beyond the limits of existing courses

Primary Courses (Departmental)

Art 383 Greek and Roman Art. See *Art and Design*

C Grk 101, 102. Elementary Greek. See *Foreign Languages and Literatures*

C Grk 201, 202. Intermediate Greek. See *Foreign Languages and Literatures*

Engl 353. World Literature: Ancient Classics. See *English*

Hist 265 Introduction to Ancient Civilization See *History*

Hist 280 Introduction to the History of Science. See *History*

Hist 402. Ancient Greece See *History*

Hist 403 Ancient Rome. See *History*

Hist 495 Proseminar in History. See *History*

Hist 512A. Proseminar in European History: Ancient. See *History*

Hist 594A. Seminar in European History: Ancient. See *History*

Latin 101, 102. Elementary Latin. See *Foreign Languages and Literatures*

Latin 201 Intermediate Latin. See *Foreign Languages and Literatures*

Latin 242 Introduction to Latin Literature. See *Foreign Languages and Literatures*

Latin 341, 342 Advanced Readings in Latin. See *Foreign Languages and Literatures*

Phil 310 Greek and Medieval Philosophy See *Philosophy*

Pol S 430 Development of Political Thought: Classical Thought through Early Contract Theory. See *Political Science*

S-H 241H The Individual, Nature, and Society: The Ancient Period. See *Sciences and Humanities*

Speech 510 Classical Rhetoric. See *Speech*

Community and Regional Planning

Riad G Mahayni, Chair of Department

Professors: Brooks, Mahayni

Associate Professors: Kihl, Knox, Lex, Malone, Parks

Assistant Professor: Rafter

Undergraduate Study

For undergraduate curriculum in community and regional planning leading to the degree Bachelor of Science, see *College of Design, Curricula*.

Community and regional planning is concerned with the economic, social, physical, psychological, and management aspects of change in a geographic or political area. The

planner must attain a broad comprehension of city, metropolitan, urban, rural region, and statewide types of development, their interrelationships, and the extent of their changing needs over the short term and the middle- and long-range future

The curriculum is recognized by the American Planning Association, thus providing the student with an education which, when combined with experience, supports the individual's eligibility towards membership in the American Institute of Certified Planners.

Graduate Study

The department offers work for the degree Master of Community and Regional Planning with major in community and regional planning

Degree requirements include completion of a 2-year, 52-credit program, including a thesis of 9 credits Minor work is offered to students taking major work in other departments

The program of graduate study is recognized by the American Planning Association

By taking work in community and regional planning and by focusing on an area of concentration, a student may develop a program with his or her selection of a special emphasis from administration, economic planning, environmental planning, transportation planning, urban design, housing and neighborhood renewal, policy analysis, state and regional planning, social planning, and planning in developing countries.

For the degree master of community and regional planning, the foreign language requirement, if any, is established on an individual basis by the program of study committee

Satisfactory completion of the core requirements and the acceptance of a thesis (9 credits) are required for the M C.R P degree In addition, the student is encouraged to complete 3 months of acceptable work experience in a planning office between his or her first and second year

The department participates in the interdepartmental minor programs in Housing, Transportation Planning, and Technology and Social Change (See *Index*)

Open to graduate students for minor credit only 380, 405, 406, 416, 432, 492, 493

Courses Primarily for Undergraduate Students

253. Survey of Urban Planning. (3-0) Cr 3 F An historical survey of planning, the nature and problems of urban areas, and the goals, procedures, and results of urban planning

270. Forces Shaping our Metropolitan Environment. (3-0) Cr 3 S , SS Introduction to the social, political, physical, and economic forces as they shape metropolitan areas and their interrelationships A comprehensive picture of metropolitan development showing important roles other urban disciplines play in the planning process and the interrelationships of the disciplines

272. Planning Analysis and Techniques. (3-0) Cr 3 S Existing and emerging techniques for preparation of community planning studies. Sources of planning information and data, analysis of population, land use, economic, and transportation make-up of a community; activities and location, intensity, and timing of land uses and public services.

293. Environmental Planning. (3-0) Cr 3 F *Prereq. Sophomore classification* Comprehensive overview of the field of environmental relationships and the efforts being made to organize, control, and coordinate environmental, aesthetic, and cultural characteristics of land, air, and water

320. Professional Practice. Cr 15. F., S., SS. *Prereq: Junior classification in community and regional planning curriculum* Structured work experience under close supervision of a professional planner Practical planning experience; relationships between theory and practice, professional responsibilities, and the scope of various planning roles.

341. Travel. Cr 1 to 3 each time taken F S. *Prereq Classification in community and regional planning curriculum* Observation of the professional practice of community and regional planning Offered on a satisfactory-fail basis only Field trips Fee

380. Regional Planning and Metropolitan Development. (3-0) Cr 3 F *Prereq 253 or 270* Analysis of the growth and changes occurring in non-metropolitan and metropolitan regions, theories and functions of area-wide planning governance structures, policies and strategies for guiding development

383. Theory of the Planning Process. (3-0) Cr 3 S *Prereq 253 or 270* The nature of planning and its relation to social and economic planning· levels of planning, place of planning in decision making, steps in the planning process, uses and limitation of knowledge in planning, relation of facts and values

395. Housing and Neighborhood Revitalization. (3-0) Cr 3 F *Prereq· 253 or 270* Guidelines for housing policy formulation as a part of the over-all planning process in urban areas Analysis of demand, supply, financing, impact of taxation, government regulation and subsidies, and revitalization of neighborhoods through public policy and private initiative

405. New Towns and Planned Communities. (3-0) Cr 3 S *Prereq 253 or 270* Survey of new town and planned community experience in the United States and abroad Goals, objectives, and policy implications of new towns, various types of new towns and their social, economic, and governance structures Review of appropriate legislation

406. State Planning (3-0) Cr 3 F *Prereq· 253 or 270, permission of instructor* The state planning process, definitions, state policies, interrelationship of state, regional, and local policies, current practices, location of the planning function, obstacles to state planning

416. Urban Design and Planning Practice. (3-0) Cr 3 S *Prereq 272, permission of instructor* Principles of urban design and their application to residential and commercial development

432. Urban Development Planning and Programming (1-9) Cr 4 S *Prereq 272* Utilization of the comprehensive planning process Preparation of selected effectuating devices for the plans produced such as community revitalization projects, codes and ordinances, and capital improvement programming Simulation of methods of analysis as applied to a specific geographic area

490. Independent Study. Cr 1 to 3 F S , SS *Prereq Permission of instructor* Investigation of an approved topic commensurate with student's interest and ability Offered on a satisfactory-fail basis only H Honors Program

492. Planning Law, Administration and Implementation. (3-0) Cr 3 F *Prereq 253 or 270* The basis in constitutional, common, and statutory law for the powers of plan effectuation Problems of balancing public and private interests as revealed in the study of leading court cases Administration of planning agencies and programs

493. Environmental Law (3-0) Cr 3 S *Prereq 492* Legal precedents, developments, and alternative policy approaches to protection, control, and development of the environmental rights, policies, regulations, and technology to land use and to water, air, and land pollution Federal environmental control acts and leading federal court cases

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

500. Topical Workshop. (1-9) Cr 4 *Prereq 272* F Planning problem, utilization of theory and methods in resolving planning issues Topic changes every year

511. Introduction to Community Planning. (3-0) Cr 3 F *Prereq Permission of instructor* Development of planning in the United States, history and evolution of the planning profession and constructs of current practice

512. Planning Communication. (2-0) Cr 2 F *Prereq Permission of instructor.* Methods of graphic, print, and media presentation for the planning professional with emphasis on technical report writing and presentation skills

515. Housing and Public Policy. (3-0) Cr 3. S. *Prereq Permission of instructor* Housing as an interdisciplinary issue the economic, political, social, and physical restraints on housing and community development policy

520. Planning Methods. (3-0) Cr 3. F *Prereq 272 or graduate classification.* Basic foundation of planning methods and analytical techniques. Planning information sources and data and their use in the analysis of community issues Application of scientific method to forecasting of demographic and land use variables.

522. Advanced Planning Methods. (3-0) Cr 3 S *Prereq. 272 or graduate classification* Advanced foundations of planning methods and techniques Analysis of economic base, input-output analysis, employment forecasting, transportation, use of computers and models in planning

524. Historic Preservation Planning. (3-0) Cr 3 F *Prereq Permission of instructor* Planning methodology employed to further preservation objectives Zoning, transfer of development rights, surveys, preservation plans, public and private financing of preservation

527. Urban Social Planning. (3-0) Cr 3 S *Prereq Permission of instructor* Review and development of methodologies for planning programming and implementing social service delivery systems Federal state, and local approaches to social policy and planning

529. Planning in Developing Countries. (3-0) Cr 3 S *Prereq Permission of instructor* A variety of planning and planning-related issues including rural-urban migration, development of national policies and programs, urban decay, rural development strategies housing problems in a developing country

531. Advanced Planning Workshop. (1-9) Cr 4 F *Prereq 520 or 522* Integration of planning methods and theory in dealing with a planning problem Analysis of problem and formulation of strategies for implementation Preparation of a planning report

561. Seminar in Planning Theory. (3-0) Cr 3 S *Prereq Permission of instructor* Current planning theories comprehensive land use, advocacy, participatory, radical, and transactive planning models Decision making and organization model as they affect planning practice Value conflicts and conflict resolution

575. Urban Planning/Urban Management. (3-0) Cr 3 F *Prereq Permission of instructor* The role planning plays as a part of the management and decision-making process, policy initiation, development, and implementation, management approaches and tools

590 Special Topics. Cr 1 to 3 F S SS
- A Urban Design
- B Historic Preservation
- C Environmental Planning
- D Urban Development Planning and Programming
- E Social Planning
- F Regional and Metropolitan Planning and Programming
- G State Planning
- H Housing
- I New Towns Planning
- J Planning in Developing Countries

592. Planning Law, Administration and Effectuation (3-0) Cr 3 F *Prereq Graduate classification in community and regional planning* Process of administration and implementation of planning programs through planning law Effective management of the urban environment Powers and duties of planning authorities and the powers of plan effectuation, problems of balancing public and private interest as revealed in study of leading court cases

Courses for Graduate Students, major or minor

699. Research. Cr var F S SS

Computer Engineering

Administered by the Department of Electrical Engineering

J O Kopplin, Chair of Department

Undergraduate Study

For undergraduate curriculum in computer engineering leading to the degree Bachelor of Science, see *College of Engineering, Curricula*.

Computer engineers engage in research, development, design, application, management, and sales in the computer industry and in a broad range of industries in which digital systems and subsystems have application. Computer engineers apply the theories and technology of computing and computers toward improvements in all the range of computing systems and devices that render a service to society.

The department offers a cooperative education program that combines classroom learning at the University with practical engineering experience in industry. Students in this five-year program complete the regular curriculum requirements for the Bachelor of Science degree and acquire carefully planned and supervised work experience at one of the cooperating companies. The first contact with industry comes after the sophomore year See *College of Engineering, Cooperative Programs*.

Courses for students who are not in the computer engineering program: 340, 440 Credit in these courses may not be counted toward a degree in computer engineering Credit in 340 may not be counted toward a degree in electrical engineering.

Credit in only one course in each of the following pairs of courses may be counted toward graduation: 280 and 340; 440 and 487

Graduate Study

A computer engineering graduate wishing to undertake graduate study will normally do so in electrical engineering or computer science. See *Electrical Engineering* and *Computer Science*

Courses open to graduate students for minor credit only: 340, 384, 385, 387, 440, 480, 481, 482, 483, 487, 488.

Courses Primarily for Undergraduate Students

***280. Introduction to Digital Techniques.** (3-0) Cr 3 F.S.SS. *Prereq: Sophomore classification* Number systems and codes. Introduction to Boolean algebra. Combinational and sequential logic design Digital systems design examples.

287. Digital Laboratory I. (1-2) Cr 2 F.S *Prereq. 280, E E 235.* Use of basic instruments such as logic probes, logic analyzers, oscilloscopes. TTL characteristics. Basic combinational and sequential circuits. Flip-flops, counters, shift registers. Arithmetic logic. Individual design projects.

298, 398, 498. Cooperative Education. Required of all cooperative students. *Prereq: Permission of department head.* 298. Work periods for students with sophomore standing in a regularly established cooperative program. 398. Work periods for juniors. 498. Work periods for seniors. Students must register for these courses prior to commencing each work period.

***340. Introduction to Digital Circuits and Systems.** (3-2) Cr 4 F. *Prereq: Math 166 or 176.* Analysis of linear and precewise linear resistive and resistive-capacitive circuits. Piecewise linear models for diodes, transistors, and operational amplifiers. Combinational and sequential logic. Logic elements. Digital representation of data. Design of digital subsystems.

384. Computer Organization and Design I. (Com S 384) (3-0) Cr 3 F S *Prereq. 280, Com S 221* Digital design languages and conventions. Descriptive realizations of digital computers. Microprogrammed control unit design. Contemporary MSI and LSI logic blocks. Arithmetic algorithms and realizations.

385. Computer Organization and Design II. (Com S 385) (3-0) Cr 3. F S. *Prereq: 340 or E E 205, and 384.* Input/output architectures. Programmed, interrupt, and direct memory access controlled data transfers. Interface design with peripheral devices and processors. Memory system architectures. Special purpose processor enhancement techniques.

387. Digital Laboratory II. (1-2) Cr 2 F S. *Prereq: 287, 384.* Use of advanced digital instruments. Experimental processor design. Bit-slice processor elements. Microprogramming experiments. Implementation of simple digital communication systems (software and hardware) Individual design projects.

***440. Computer Based Instrumentation and Control.** (3-2) Cr 4 S *Prereq: 340, or 280 and E E 205 or E E 441.* Introduction to computer based instrumentation and control Logic devices, analog-to-digital and digital-to-analog converters, instrument buses (IEEE 488 and S100), personal computers, software support, system examples, data acquisition and control systems

480. Digital System Design. (3-0) Cr 3. F *Prereq: 385* Design of total digital systems including hardware and software. Specifications, life cycle costs, design cycles, documentation (flow charts, block diagrams, logic diagrams, timing diagrams, mechanical diagrams), automated design aids including MACSYM and automated layout programs, circuit and system problems including noise and reflections, design reliability and redundancy in systems, and the engineering and life-cycle costs of software including maintenance and documentation.

481. Digital Systems Design Laboratory I. (1-2) Cr 2 F *Prereq: 385, 387* Experiments in the design of digital systems Fee

482. Digital Systems Design Laboratory II (1-2) Cr 2 S *Prereq: 481.* Projects in digital system design Fee

483. Switching Theory. (3-0) Cr 3 F S *Prereq 280.* Analysis and synthesis of combinational and sequential circuits

***487. Introduction to Microprocessors.** (3-3) Cr 4 F S *Prereq. 384, E E 436 or 437* Introduction to microprocessors. Microprocessor architecture and associated microcomputer systems. Consideration of peripheral systems parts and hardware/software tradeoffs Software examples. Top-down designs are explored in a variety of examples.

488. Digital Systems: Digital and Nondigital Interfacing. (3-0) Cr 3. *Prereq. 487.* Conversion of physical parameters to digital form, transducers. Digital data transmission, telemetry Man-machine interaction. Interface design. Interface standards.

490. Independent Study. Cr arr *Prereq: Senior classification in computer engineering* Investigation of an approved topic
H. Honors.

*See paragraphs above course listing for credit restrictions.

Computer Science

Robert M Stewart, Jr , Chair of Department

Professors: Brearley, Keller, Lambert, Maple, Mosier, Stewart, Zingg

Associate Professors: Grosvenor, Kafura, Oldehoeft, Ostendorf, Selman, Strawn, Wright

Assistant Professors: Blair, Eckstein, Krishnaswamy, Schneider

Undergraduate Study

For undergraduate curriculum in sciences and humanities, major in computer science, leading to the degree Bachelor of Science, see *Sciences and Humanities, Curriculum.*

The curriculum in sciences and humanities with major in computer science is designed to prepare students for graduate study in computer science, or for positions as computer scientists with business, industry, or government. Areas of emphasis exist in programming language structure, systems programming, applications programming, computer system structures, and information structures.

The requirements for an undergraduate major in computer science include the following: 33 credits in computer science, some of which are specified by the Department of Computer Science, with the remainder selected by the student, one of the following sequences in mathematics - Math 165, 166 or Math 175, 176 or Math 150, 151, 307. For additional requirements, see the Computer Science Department.

It is recommended that majors include in their programs of study a strong minor in a field of application of computer science, and, particularly for those who plan on graduate study, one or two years of French, German, or Russian

Computer science majors may obtain a secondary school teaching certificate by pursuing a cooperative program with mathematics, leading to certification as a teacher of mathematics.

The following courses may not be included in the 33 credits required of computer science majors: 170, 172, 200, 201, 470 (except in certain combinations as specified by the Computer Science Department).

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with a major in computer science and minor work to students majoring in other departments.

Facilities exist for fundamental research in such areas as programming languages, computer architecture, operating systems, information structures and theoretical foundations.

A student desiring to do graduate work with a major in computer science should ideally have completed a bachelor's degree or equivalent in computer science. Students with a major in a related area such as electrical engineering or mathematics are also encouraged to apply.

For the degree Master of Science, 31 semester credits are required. Both thesis and non-thesis options are available. If no thesis is presented, the preparation of a paper demonstrating ability to organize and express significant ideas in computer science is required.

For the degree Doctor of Philosophy, a student is expected to demonstrate a high degree of proficiency in reading, writing and speaking skills. To insure such skills, the student must include in his program of study a demonstrated proficiency in either a foreign language or in communication skills.

All graduate students are required to pass a series of area examinations over the core areas of the graduate course offerings. The examinations are normally scheduled within the first two years of a student'a graduate program.

The Department of Computer Science participates in the interdepartmental program Technology and Social Change. Students majoring in computer science may elect a minor in Technology and Social Change.

The Department of Computer Science recommends that all graduate students majoring in computer science teach as part of their training for an advanced degree.

Courses open to graduate students for minor credit. 311, 332, 352, 375, 411, 432, 441, 452, 470

Courses Primarily for Undergraduate Students

*111, 112. Computer Programming I, II. (3-0) Cr 3 ea 111 F S, 112 F S *Prereq 111 Math 140 or 150, 112: 111, and Math 151 or 160 or 165 or 175* A two-semester introduction to computer programming and data structures emphasizing algorithm development and programming style A block-structured language will be used Emphasis on writing and running programs

170. Computer Applications and Impact. (2-0) Cr 2 F *Prereq Sophomore classification.* Survey of computer operations file management, gaming, CAI, process control, simulation and modeling Impact of computers on individuals and society Approaches to problem solving using computers with emphasis on analysis and formulation of algorithms Projects chosen from various application areas of student interest

*172. Computer Programming in FORTRAN. (2-0) Cr 2 F S *Prereq Credit or classification in Math 165 or 175* Introduction to computer programming using the FORTRAN language Emphasis on design, debugging and testing of algorithms Engineering and physical science applications stressed For students in engineering and physical science

*175. Applied Computer Programming. (3-0) Cr 3 F S *Prereq Math 104 or 140 or 150* Introduction to computer programming for non-majors using a block-structured language Basics of good programming, computer systems, files, query languages.

*176. Computer Programming. (4-0) Cr 4 F *Prereq 175, and Math 151 or 160 or 165 or 175* Computer programming and data structures Emphasis on writing and running programs

*200. Language Proficiency Laboratory. (0-2) Cr 1 each language selected F S *Prereq 111 or 175* Instruction to provide students with a working knowledge of selected, commonly available programming languages

*201. Computer Programming in COBOL. (2-0) Cr 2 F *Prereq 111 or 175.* Computer programming using the COBOL language Emphasis on the design, writing, debugging and testing of programs that store and process data using basic computer file concepts

211 File Organization and Processing. (3-0) Cr 3 F S *Prereq 112 or 176, and 221.* Concepts and techniques of structuring and processing data on external storage devices. Record and file concepts Blocking, compaction and sequential/direct access methods File utilities. Linked lists and tree manipulation

221. Machine Organization and Assembly Language Programming. (3-0) Cr 3 F,S *Prereq. 111 or 175* Organization of computer systems as a hierarchy of levels and languages Instruction sets and addressing techniques. Assembly language programming and assembler construction

260. Discrete Computational Structures. (3-0) Cr 3 F *Prereq. 112 or 176 and Math 165 or 175 or 307* Concepts in discrete mathematics as applied to computer science Each mathematical topic will be introduced and strongly motivated by coupling it closely with realistic applications to problems of computer science Propositional logic applied to program correctness, set theory applied to data structures, graph theory and combinatorial techniques applied to decision trees, Boolean algebra applied to switching theory, and algebraic structures applied to modular arithmetic

290. Independent Study. Cr arr F,S *Prereq. Permission of instructor*
H Honors.

300. Cooperative Education. Required of all cooperative students *Prereq: Permission of department chairman* Students must register for this course prior to commencing each work period

311. Data Structures and Algorithm Analysis. (3-0) Cr 3 S *Prereq: 211, 260.* Basic techniques for design and analysis of efficient algorithms, sorting, graph processing, and memory management algorithms The investigation of a simple data base management system will provide an applications environment for topics discussed in this course.

332. Principles of Programming Languages. (3-0) Cr 3 F *Prereq. 211* Organization of programming languages emphasizing their run time implementation Introduction to formal specification of programming languages. Programming in several languages

352. Introduction to Operating Systems. (3-0) Cr 3 S *Prereq 211, Cpr E 384* Survey of operating system issues Introduction to hardware and software components including processors, peripherals, interrupts, process and memory management, deadlocks, file systems, protection, virtual machines and system organization

375. Applied Information Processing Systems. (3-0) Cr 3 S *Prereq 111 or 175 and knowledge of COBOL* Computer-oriented information systems concepts, introduction to systems analysis, working with a job control language, applying access methods, introduction to data base systems, batch and interactive projects using a business language

384. Computer Organization and Design I. (Cpr E 384) See *Computer Engineering*

385. Computer Organization and Design II. (Cpr E 385) See *Computer Engineering*

411. Software Engineering. (2-2) Cr 3 S *Prereq. 311* Principles and techniques for methodical construction of quality software. Software requirements and objectives, reliability; design methodologies, module specification techniques, testing and validation procedures, proof of program correctness Emphasis on team projects

432. Principles of Compiling. (3-0) Cr 3 S *Prereq 260, 332* Techniques of compiler and interpreter construction are studied Lexical analysis, modern top-down and bottom-up parsing techniques, syntax directed translation, and code generation

441. Computer Based Information Systems. (3-0) Cr 3 F *Prereq 311, 352* Advanced file concepts and access methods, data base management systems concepts and implementation, data dictionary structures, computer systems concepts for supporting data base systems, language considerations, computer center organizational structures, computer center information system project

452. Implementation of Operating Systems. (2-2) Cr 3 F *Prereq 352* Laboratory course emphasizing the practical issues of operating systems design and implementation Source code for a hierarchically structured system. Additions, replacements, or extensions to this system will be required as an individual or team project

470 Computing Methods for Research Workers (3-0) Cr 3 S *Prereq 111 or 172 or 175 or graduate classification and one course in college level mathematics or statistics* Role of computers in research Use of computing facilities in research work Structured problem solving and programming methods General analysis of programming languages available for research Use of utilities, command languages and files in research projects

471 Computational Linear Algebra and Fixed Point Iteration. (Math 471) See *Mathematics*

481 Numerical Solution of Differential Equations and Interpolation. (Math 481) See *Mathematics*

490 Independent Study Cr arr F S *Prereq Permission of instructor*
H Honors

495 Seminar Cr arr F S *Prereq Permission of instructor*

*Credit for only one of the following pairs of courses may be applied toward graduation. 175, 176 and 111, 112. Credit for only one course in each of the following pairs may be applied toward graduation: 200 (COBOL) and 201; 172 and 200 (FORTRAN).

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

501. Computer System Architecture. (3-0) Cr 3. F *Prereq. 352.* Development of programming models of special purpose and general purpose computer systems Alternative implementations of computer systems Speed-cost tradeoffs, microprogrammed control

507. Numerical Solution of Ordinary Differential Equations. (Math 507) See *Mathematics*

509. Computational Methods of Linear Algebra. (Math 509) See *Mathematics*

511. Principles of Algorithm Design and Analysis. (4-0) Cr 4 F *Prereq 311* Semantics of data structures, advanced data types, design, development and analysis of algorithms. Review of program structure, proofs of correctness

521, 522. Theory and Design of Operating Systems. (3-0) Cr 3 ea. 521 S 522 F *Prereq 521: 501, 511, 522 521* Control of concurrent processes, primitives for process synchronization and communication, introduction to processor scheduling and queuing systems, file systems, protection The detailed implementation of a fully functional operating system will be examined in support of these topics

531, 532. Theoretical Foundations. (3-0) Cr 3 ea. 531 F 532 S *Prereq 531 260, 532 531* Introduction to analytical methods and techniques used in the study of computer science Finite automata and regular sets, context-free grammars, pushdown automata, Chomsky hierarchy, decidable and undecidable problems, primitive and partial recursive functions, basic recursive function theory and topics from general and automata-based complexity theory

541, 542. Programming Languages. (3-0) Cr 3 ea 541 S 542 F *Prereq: 541 432, 511 and 531, 542 541* Semantics of a wide array of programming language features, theory and practice of compilation of high level languages

584. Digital System Organization. (E E 584) See *Electrical Engineering*

585. Digital Systems Design. (E E 585) See *Electrical Engineering.*

589. Advanced Digital System Architecture. (E E 589) See *Electrical Engineering*

590. Special Topics. Cr arr *Prereq Permission of instructor*

599. Nonthesis Research Cr arr

Courses for Graduate Students, major or minor

610. Seminar. Cr arr

621, 622. Advanced Theory of Operating Systems. (3-0) Cr 3 ea. 621 Alt S, offered 1982, 622 Alt S, offered 1983 *Prereq. 621 522, 622 522* Advanced topics in the theory, design, and modeling of operating systems

641 Semantic Models for Programming Languages (3-0) Cr 3 S *Prereq 542* Interpretive, denotational, and logically based models of semantics, application of semantics to program correctness, language specification, and translation

699 Research.

Construction Engineering

Administered by the Department of Civil Engineering

John G Russo, Professor in Charge

Professor: Jellinger

Associate Professors: Russo, Ward

Assistant Professors: Chase, Hastings, Ranch, Ringwald, Roth

Instructor: Dickinson

Undergraduate Study

For undergraduate curriculum in construction engineering leading to the degree Bachelor of Science, see *College of Engineering, Curricula*

Construction engineering is a curriculum administered by the Department of Civil Engineering designed to prepare students for work as professional constructors. Professional construction requires persons with a strong fundamental knowledge of engineering and management principles, and a knowledge of business procedures, economics, and human behavior. Graduates of this curriculum may expect to engage in preparation of construction cost estimates, construction planning and scheduling, management, materials procurement, equipment selection, and cost control. The curriculum blends the study of engineering, management, and business sciences to achieve the background required as a constructor The curriculum offers a choice of three study emphases. These are concerned with building, heavy, and mechanical construction.

Interested, qualified students in construction engineering have the opportunity to participate in a cooperative education program to supplement academic work with work experience in the construction industry. See *Cooperative Education Programs, College of Engineering.*

Graduate Study

Courses are offered for minor work to students taking major work in other curricula or in interdepartmental programs.

Open to graduate students for minor graduate credit only: 346, 371, 372, 440, 441.

Courses Primarily for Undergraduate Students

100. **Technical Lecture.** (1-0) Cr R S. Last 8 weeks An examination of the nature, scope, and extent of the construction industry An overview of the educational preparation necessary for the constructor in contemporary society

241. **Analysis of Construction Materials and Methods.** (3-0) Cr 3 F S.SS. *Prereq: Phys 221* Introduction to materials and methods of building construction Foundation, structural framing, floor, roof, and wall systems. Mechanical and electrical installations Field trip and fee required

245. **Construction Contract Documents and Administration.** (3-0) Cr 3. F S.SS *Prereq 241 or Arch 311* Construction documents and their administrative uses. Definition, interpretation, and utilization of drawings, specifications, construction contracts, bidding documents, general and special conditions, and associated contract documents. Definition and administrative aspects of insurance and bonding. Labor management relations and pertinent labor legislation.

298, 398, 498. **Cooperative Education.** Required of all students in cooperative education. *Prereq: Permission of professor in charge.* 298: Work periods for students with sophomore standing. 398: Work periods for students with junior standing. 498. Work periods for students with senior standing. Cooperative education students must register in the applicable course prior to commencing each work period

311. **Industrial and Construction Safety.** (I Ed 311) See *Industrial Education.*

346. **Construction Estimating and Cost Control.** (2-3) Cr 3 F.S. *Prereq: 245, C E 215, and credit or classification in Acct 284 and I E 304.* Cost aspects of construction Quantity takeoff methods, labor and equipment production rates, unit costs, overhead, and profit as they relate to the preparation of construction estimates. Creation and coordination of cost control systems with regard to engineering, estimating, construction, and accounting operations. Purchasing and subcontracting procedures for construction projects. Construction financing by owners and contractors.

350. **Planning Construction of Institutions.** (2-0) Cr. 2. S. *Prereq: Junior classification.* Interpretation and applications of construction plans and specifications. Materials and methods in institution construction

Relationship between members of the construction team. Introduction to scheduling techniques. Not available to construction engineering students for graduation credit.

371. **Construction Organization and Management.** (3-0) Cr. 3. F.S. *Prereq. 245.* Construction company organization, operation, and administration. Proper utilization and direction of manpower at the field and office level Interactive processes necessary for efficient communication and resolution of field and office construction related problems.

372. **Heavy Construction Equipment and Methods.** (1-3) Cr 2 F S. *Prereq. 346, C E 360, I E 304.* Factors influencing the selection and purchase of construction equipment. Application of engineering fundamentals to performance and production and analysis of characteristics and capabilities of construction equipment Methods of heavy construction. Project mobilization and site organization Field trip and fee required

400. **Professional Development.** (1-0) Cr ½. F S Eight weeks *Prereq: Senior classification in construction engineering* Employment opportunities, resume preparation, interviewing techniques, professional registration, current changes and problems in the construction industry, and industry associations.

440. **Concrete and Steel Construction.** (2-2) Cr 3. F S. *Prereq: 346, E M 324.* Planning and field engineering for concrete and steel construction Design and construction of concrete formwork. Applications of formwork to concrete construction. Erection methods for structural steel systems. Field trip and fee required.

441. **Construction Planning, Scheduling and Control.** (2-2) Cr 3 F S *Prereq: 346, Com S 172* Planning and scheduling of construction projects. Computer applications to construction scheduling Applications of scheduling to cost control and resource leveling

460. **Construction Engineering Analysis and Applications.** (2-0) Cr 2. F.S. *Prereq: Senior classification in construction engineering.* Project analysis and application of construction engineering principles to the solution of a broad spectrum of construction problems.

490. **Independent Study.** Cr 2 to 5 each time taken F S.SS *Prereq. Permission of professor in charge* Individual study in construction engineering with emphasis in the field of construction operations, engineering, or technology

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

550. **Construction Management Functions and Processes.** (2-0) Cr 2 F *Prereq: 371.* Analysis of critical construction management and organizational systems, especially those involved in proper field and jobsite construction company operations Emphasis on case studies and analysis of construction company operations.

565. **Case Histories in Construction Documents.** (3-0) Cr 3 S *Prereq. 371, I E 480* Study of cases involving disputes encountered by management in construction contract documents Analysis of common points of dispute and methods of avoiding disputes among the owner, architect, engineer, and construction contractor for a project.

570. **Marketing Construction Services.** (2-0) Cr. 2. F *Prereq. 371.* Specific functions involved in marketing construction services. Need for construction marketing, market area and research, planning and objectives, operations, and personnel. Areas of image, publicity, jobsite arrangement, and promotional activity. Analysis techniques and analysis of existing construction company marketing systems.

590. **Special Topics.** Cr 2 to 5 each time elected. F S.SS *Prereq: Permission of professor in charge.* Study and report preparation in selected areas of construction materials, equipment, operations, planning and scheduling, and management.

Design Studies

Herbert W Gottfried, Associate Dean of Design

Professors: Brooks, Gottfried

Associate Professor: Robinson

Assistant Professor: Maechling

Undergraduate Study

Courses listed below are offered for students in all university curricula.

Graduate Study

The following courses are offered for graduate minor work. 426, 490, 580.

Courses Primarily for Undergraduate Students

121. **History of Design.** (3-0) Cr. 3. F.S. Study of issues and artifacts, their relation to the traditional and changing role of the creators, and to western culture.

127. **Non-Western Environmental Arts.** (3-0) Cr. 3. F.S. Interrelationships of architecture, landscape architecture, urban design, painting, sculpture, and related arts in the non-western world

137. **Design and Society.** (3-0) Cr. 3. F.S. Introduction to select contemporary design issues and modes of professional design activity in relation to the broader dimensions of individual and social life Issues range from the personal demands of creative expression in professional development to the challenge of shaping human environments to meet social needs.

140. **Fundamentals of Visual Expression and Communication.** (1-6) Cr. 3. F.S.SS. *Prereq: Credit or classification in 121 or 137 or Art 102.* Introduction to drawing and fundamentals of visual expression and communication, with emphasis on design elements and principles, perception, and visual literacy.

145. **Design Studio.** (1-6) Cr 3 F.S *Prereq: 140* Introduction to the interdisciplinary nature of the roles of the art and design professions in dealing with the designed environment and the "greater" environment.

226. **The Design Process in the Environmental Arts.** (3-0) Cr. 3. F. The role of designer, materials, and processes involved in the creation of various environmental arts.

426. **Criticism of Design.** (3-0) Cr 3 F S. *Prereq: Arch 321 or Art 280 or CRP 383 or LA 271.* Developing and exercising a process of critical evaluation of designed objects varying in size and complexity.

446. **Design Studio.** (1-6 to 1-15) Cr. 3 to 5. F.S. *Prereq: Permission of instructor.* Interdisciplinary design problems of increased complexity.

480. **Interdisciplinary Studies.** Cr. 2 to 5 each time taken *Prereq: Permission of instructors.* An interdisciplinary approach to the examination of a topical issue of interest to the College of Design. Faculty from more than one discipline.
H. Honors.

490. **Independent Study.** Cr. 2 to 4 each time taken. *Prereq: Permission of instructor; advance reservation.* Investigation of an approved topic commensurate with the student's interest and ability.
H. Honors.

Courses Primarily for Graduate Students, minor only

580. **Advanced Interdisciplinary Studies.** Cr. 2 to 5 each time taken. *Prereq: Permission of instructors.* An interdisciplinary approach to the examination of a topical issue of interest to the College of Design. Faculty from more than one discipline.

Earth Sciences

Bert E. Nordlie, Chair of Department

Professors: Biggs, Lemish, Nordlie, Seifert, Vondra, Yarger

Emeritus Professors: Hussey, Roy

Associate Professors: Cody, DeLuca, Hallberg, Palmquist, Rahman, Takle

Assistant Professors: Chen, Dobosy, Jacobson, C. Richardson, S Richardson, Sayre, Vaughan, Windom

Undergraduate Study

The department offers courses in geography, geology, and meteorology. Majors can be earned in earth science, geology, and meteorology leading to either the Bachelor of Science or Bachelor of Arts degree A geography program is available within the earth science major. Candidates for all degrees must satisfy the requirements established by the College of Sciences and Humanities (see *Sciences and Humanities, Curriculum*). In addition, the department has requirements for each major

The earth science major is a broad program that typically emphasizes an interdisciplinary field Programs leading to the Bachelor of Science degree may be individually designed but will include required courses in geography, geology, and meteorology; and required supporting work in chemistry, physics, and mathematics. Suggested specific programs have been designed in certain fields such as land use planning and environmental studies Programs leading to the Bachelor of Arts degree emphasizing geography and earth sciences teaching are available. The latter program must satisfy the requirements of the Teacher Education Program (see *Sciences and Humanities, Cross-Disciplinary Studies*).

The Bachelor of Science in geology stresses the needs of the professional geologist. Required geology courses total 48 credits and include Geol 100 or 210, 211, 231, 241, 302A, 341, 355, 365, and 471 plus 7 or 8 credits of electives in geology courses. Required supporting courses include Chem 163, 163L, 164, 164L, Phys 221, 222 and 224; Math 175, 176 and 265, and an introductory level statistics course The Bachelor of Arts in geology allows more breadth in course work with fewer requirements and more electives. Geology requirements total 39 credits and include Geol 100 or 210, 211, 231, 241, 302A, 341 and 355 and 8 credits in geology electives. Required supporting work includes Chem 163, 163L, 164, and 164L, Phys 221, 222, and 224 (or 111, 112, and 224), Math 175, 176 (or 165, 166), and an introductory level statistics course Students majoring in meteorology usually earn the Bachelor of Science degree The program normally includes the following courses: Mteor 206, 301, 302, 341, 342, 443, 454, and 455. Supporting work is required in Chem 163, 163L, 164; Phys 221, 222; Math 165, 166, 265, 266; Com S 172; Stat 105 For students anticipating graduate study, minor work is recommended in a mathematical or physical science Other students can choose a wide range of supporting courses that meet their specific interests in meteorology A strong background in geography can be obtained with the earth science Bachelor of Arts degree In addition to the core courses in geography, there is a wide range of supporting courses in other departments Programs leading to a concentration in either physical or cultural geography are designed on an individual basis

Graduate Study

The department offers programs leading to the Master of Science and Doctor of Philosophy with majors in earth science, geology, and meteorology. The department also cooperates in the interdepartmental program in Water Resources (see Index) Students desiring a major in the above fields normally will have a strong undergraduate background in the physical and mathematical sciences. Individuals desiring to enter a graduate program are evaluated by considering their undergraduate preparation and their expressed goals

Programs of study are designed on an individual basis in accordance with requirements of the Graduate College and established requirements for each departmental major. Minor work is normally taken in aerospace engineering, chemistry, computer science, engineering mechanics, mathematics, metallurgy, physics, soils, soils engineering, statistics, or zoology Departmental requirements provide a strong, broad background in the major and allow considerable flexibility in the program of each individual

A dissertation is required of all Ph.D candidates M.S. students normally are required to complete a thesis, although a nonthesis option is offered for the M.S. degree in earth science and in meteorology. The department requires all graduate students to do some teaching as part of their preparation for an advanced degree

Candidates for the Ph D degree are required to submit proof of reading knowledge of two foreign languages or reading and speaking knowledge of one The candidate's graduate committee may accept, as proof of mastery, either course grades in language courses taken at Iowa State University or a suitable score on a comprehensive examination.

The following courses are open to graduate students for minor graduate credit only. Geog 324, 490, 495, Geol 302A, 341, 355, 365, 380, 390, 398, 471, 482, 484, 486, Mteor 301, 302, 341, 342, 406, 443, 454, 455

Geography (Geog)

Primarily for Undergraduate Students

100. Principles of Geography. (3-0) Cr 3 F S Rahman Introduction to the geographer's view of the world: regionalization, spatial interaction, people-land relationships, migration, modernization and underdevelopment, urbanization, emphasis on applied examples.

202. Physical Geography. (2-2) Cr 3 S The interrelating physical characteristics of earth's atmospheric, hydrospheric, and lithospheric systems as they relate to climate, soil, and landform development and the impact of their spatial distribution on occupants of earth Field trips

301. Cartography (C E 301) (1-4) Cr 3 F Rahman Basic principles of cartographic communication transformation, cartographic geometry, and projection, symbolization; history of cartography Labs emphasize development of applied skills map design, compilation, drafting, lettering, reproduction Students required to purchase drafting kit and lab materials

324. Cultural Geography. (2-0) Cr 2 F Rahman Origin distribution and influence of cultural processes such as discovery, invention, evolution, and diffusion of phenomena on the landscape

325. Cultural Geography: Asia, Africa. (2-0) Cr 2 S Rahman People and their environment in Asia, Africa Evolution of cultural landscape and culturo-geographic regions Emphasis on areas of current concern

326. Man and Land in Anglo America. (2-0) Cr 2 Alt S, offered 1982 Rahman Analysis of the physical and cultural features that characterize and differentiate the landscapes and regions of the United States and Canada.

328. Europe. (2-0) Cr 2 Alt S, offered 1983 Rahman Topical study of areal variation in the physical and human environment; management of resources, settlements, political, and economic developments

484. Remote Sensing for Environmental Analysis. (Geol 484) See *Geology*.

484L. Remote Sensing Laboratory. (0-2) Cr. 1 Alt F *Prereq: Concurrent enrollment in Geol 484* Interpretation of physical and cultural landscapes, especially natural resources, land use, agricultural resources, and settlements

490. Independent Study. Cr 2 to 4 each time taken *Prereq. 2 credits in geography*

495. Summer Field Study. Cr 4 to 6 SS *Prereq 4 credits in geography, permission of instructor* Correlated readings and field work Four to six week field trip to a selected region in the U.S or abroad to study cultural or physical geographic relationships Written report required

Geology (Geol)

Primarily for Undergraduate Students

100. Geology and Man. (2-2) Cr. 3. F.S.SS Palmquist Origin of earth materials, landforms, and structures, emphasis on those aspects important to understanding the human environment Optional field trips, lab fee

203. Geology Field Trip. Cr 1 each time taken F S *Prereq. 100, permission of instructor.* Vondra. Geology of selected regions studied by correlated readings followed by a field trip to points of geologic interest Ten day field trip required Field trip fee

205. Introduction to Oceanography. (2-0) Cr 2 S DeLuca. Principles and concepts in oceanography as a basis for understanding the uses, potential uses, and limitations of oceanic and coastal environments

207 Geologic Environment and Hazards. (2-0) Cr 2 S *Prereq 100* DeLuca Application of geological concepts to the analysis of the interaction between people and the geologic environment volcanoes, groundwater, construction sites, and land use patterns

210. Principles of Modern Geology. (3-2) Cr 4 F S *Prereq. High school chemistry or physics* Seifert, Windom Earth materials, processes and history from the atomic to global scale, emphasis on application of physical and chemical concepts to geologic phenomena Primarily for science majors Field trip, lab fee

211. History of the Earth. (3-2) Cr 4 S. *Prereq. 100 or 210* Vondra. The earth's physical and biological evolution encompassing concepts of global tectonics Emphasis on methods used to decipher earth history Fee

231. Biogeology. (2-2) Cr 3 S *Prereq 211* Cody Interrelationships of biologic and geologic systems Nature of the fossilization process, characteristics of fossils, uses of fossil remains in determining paleoecology, paleogeography and broad trends in evolution Field trip, lab fee

241. Mineralogy and Crystallography. (4-2) Cr 5 F *Prereq: 210 or 100, Chem 163* Windom, Cody Common rock-forming minerals. Mineral classification, crystal chemistry, elementary crystallography, crystal morphologies, and mineral genesis. Laboratory involves problems in crystallography and mineral identification

290. Independent Study. Cr 2 to 4 each time taken *Prereq Permission of instructor*

301. Geology for Engineers. (1-2) Cr 2 F S Lemish, Richardson. Fundamentals of geology with engineering applications Field trips, lab fee

302A, 302B. Summer Field Studies. Cr 6 to 8 SS *Prereq. 231, 241, 355.* Vondra. 302A. Areal mapping, structural, stratigraphic, and geomorphologic analyses Written reports with appropriate illustrations required An 8-week summer field course required of all geology majors Fee. 302B. Emphasis on geological processes and products; secondary attention to related ideas in environment An 8-week summer field course required of all non-geology, earth science majors Fee

341. Determinative Mineralogy. (2-3) Cr 3. F *Prereq. 241, Phys 112 or 222 (preferred), Math 175* Biggs. Technique oriented study of mineral determination Relationships between crystallographic, chemical, and optical properties

355. **Structural Geology.** (2-4) Cr. 4 S. *Prereq: 100 or 210, Phys 111 or 221 (preferred), Math 175.* Lemish Description and classification of structures in sedimentary, metamorphic, and igneous rocks. Introduction to mechanical principles as related to deformational behavior of rock bodies in different environments. Laboratory includes application of geometrical techniques to solve structural problems, emphasizes map interpretation and use of stereonet.

365. **Petrology.** (3-4) Cr. 5. S. *Prereq: 302A, 341.* Biggs, Seifert Nature and origin of igneous, sedimentary, and metamorphic rocks as a function of environmental conditions Emphasizes description of rocks and conditions of formation Microscopic study and classification of rocks in thin section.

377 **Landforms.** (2-2) Cr. 3. Alt. S. *Prereq: 100* Palmquist Analysis of landscapes developed by rivers, glaciers, or waves Emphasis on interpretation of origin and history Field trips.

380 **Introduction to Geophysics.** (3-0) Cr 3 F *Prereq 302A, Phys 112 or 222 (preferred).* Sayre Application of physical principles to determination of subsurface rock structure or boundaries or both Includes seismology, gravitometry, magnetometry, and techniques of electrical and radioactivity surveying Field application of geophysical methods to include data acquisition, computer processing and interpretation Fee

390 **Geology of Iowa and the Midwest.** (2-0) Cr 2 SS *Prereq 15 credits in natural sciences.* Lemish. Evolution of stratigraphic, structural, and geomorphic features of Iowa and their economic significance Primarily for teachers Field trips.

398. **Minerals, Rocks, and Fossils.** (1-2) Cr 2 SS *Prereq 15 credits in natural sciences* DeLuca. Classification and significance of rock-forming minerals, crust-forming rocks and fossils as records of crustal evolution Primarily for teachers. Field trip

400. **Advanced Field Geology.** Cr 6 to 8 SS *Prereq. 302A* Vondra An 8-week field course for advanced geology majors emphasizing advanced field techniques and providing students with experience in analyzing geologic field problems Fee

471. **Erosion and Sedimentation.** (4-2) Cr 5 F *Prereq 302A and an introductory statistics course* Palmquist, Vondra. Wealhering; erosion and erosional surfaces, interpretation of landforms; source, dispersal, accumulation, and diagenesis of sediments in terrestrial, transitional, and marine environments Field trips

482. **Economic Geology.** (2-1) Cr 3 F *Prereq 365* Review of major ore concentration processes Nature and origin of economic mineral deposits Review of industrial mineral and fossil fuel deposits with major emphasis on metallic deposits Lab study of economic minerals and problems in mineral reserves

484. **Remote Sensing for Environmental Analysis.** (Geog 484) (2-0) Cr 2 Alt F *Prereq 100, 210, or 301 or Geog. 100 or 202; concurrent enrollment in Geol 484L or Geog 484L.* Principles of remote sensing, interpretation of land patterns based on their physical, geologic, biologic and cultural images.

484L. **Remote Sensing Laboratory.** (0-2) Cr 1 Alt F *Prereq: Concurrent enrollment in Geol 484.* Geomorphic, lithologic, and structural interpretation of remote sensing data.

486. **Geology of North America.** (3-0) Cr 3. Alt S *Prereq. 355.* Geologic evolution of North America as interpreted from structural and stratigraphic relationships of the geological provinces.

490. **Independent Study.** Cr 2 to 4 each time taken *Prereq: Permission of instructor.*

Primarily for Graduate Students, major or minor, open to qualified undergraduates

534. **Advanced Paleontology.** (2-2) Cr 3. S. *Prereq: 231, 471.* Cody, Vondra. Selected topics in paleontology and paleoecology: sedimentary environments and their effects on organisms, stratigraphic correlation, interpretation of earth history, advanced morphologic descriptions of fossils.

540. **Mineral Chemistry and Physics.** (3-0) Cr 3. F *Prereq: 341.* Windom. Fundamentals of crystal chemistry and application to common rock-forming minerals, especially silicates. Formation of elements, chemical bonding, polyhedral packing, crystallography, mineral genesis and metamorphism, physical properties of minerals.

544. **Optical Mineralogy.** (2-2) Cr 3. S *Prereq: 540.* Biggs. Theory of birefringence and transmission of light and related stimuli through crystalline matter Optical properties of common mineral groups.

546. **Clay Mineralogy.** (1-2) Cr 2. S *Prereq. 241* Cody Origin, geological significance, structure, and chemistry of clay minerals. techniques of identification and characterization of common clay and clay-size minerals

550. **Advanced Structural Geology.** (1-2) Cr 2 S *Prereq 355* Lemish Review of mechanical principles of rock deformation and development of secondary texture Tectonic analysis and structural association. Stereonet, statistics, descriptive geometry, and map interpretation and contouring

560. **Advanced Petrology.** (2-2) Cr 3 S *Prereq: 365.* Biggs, Seifert Formation and alteration of rocks as function of environmental conditions. Phase equilibria, crystallization, magmatic evolution, diffusion, recrystallization

564. **Metamorphic Petrology.** (2-2) Cr 3 F *Prereq 560* Seifert Mineral assemblages and textures of contact, dynamic and regionally metamorphosed rocks, processes of recrystallization and deformation as a function of environmental conditions, regional patterns of metamorphic belts

566. **Sedimentary Petrology.** (1-4) Cr 3 S *Prereq 560* Biggs Origin, diagenesis, and petrologic implications of sedimentary rocks.

567. **Solar System Planetology.** (2-3) Cr 3 Alt F *Prereq: 355, 365* Richardson Origin and evolution of the solar system, emphasis on meteorites and geologic evolution of terrestrial planets Constraints on models of the early earth as derived from the petrology and dynamics of the Moon, Mars, Mercury, and Venus

570. **Principles of Stratigraphy.** (3-0) Cr 3 F *Prereq 231, 471* Vondra. Basic concepts in stratigraphy, stratigraphic subdivision and nomenclature, correlation, facies and facies analysis, sedimentary tectonics, and basin analysis

573. **Quaternary Geology.** (3-0) Cr 3 S *Prereq 471* Palmquist Character and interpretation of landforms and sediments formed during the Quaternary Field trips

576. **Clastic Sedimentation** (2-2) Cr 3 S *Prereq: 570* Vondra. Interpretation of clastic sedimentary rocks to infer processes, environments, and tectonic settings under which they formed Major clastic facies of selected regions studied and analyzed Field trips

577. **Chemical Sedimentation.** (2-2) Cr 3 S *Prereq. 471* Cody Survey of the origin and characteristics of recent and ancient chemical sediments clays, carbonates, phosphates, zeolites, and sulfates

580. **Geomorphology.** (2-0) Cr 2 F *Prereq: 471* Palmquist Processes and forms in surficial systems Emphasis on fluvial and glacial systems

582. **Advanced Economic Geology.** (3-0) Cr 3 F *Prereq: 482, 560* Lemish Review of major principles related to ore concentration and deposition. Geology applied to exploration and development of mineral deposits and fossil fuels. Problems related to ore genesis.

585. **Geotectonics.** (2-0) Cr 2 S. *Prereq. 365, 471* Windom. Global processes considered within the framework of plate tectonics Continental drift, sea-floor spreading, the nature of the crust and mantle, island arcs and continental margins, magmatism and metamorphism, paleomagnetism and seismology.

586. **Groundwater Geology.** (2-2) Cr 3. S. *Prereq: C E 371* Sayre. Occurrence and distribution of subsurface water; nature of conducting media.

587. **Mineral Equilibria.** (3-0) Cr 3. S *Prereq: 588.* Windom The phase rule and thermodynamic basis of mineral equilibria. Interpretation of geologically relevant phase diagrams including isobaric liquidus and subsolidus diagrams, pressure-temperature diagrams, log f_2-T diagrams and Eh-pH diagrams. Special emphasis on effect of pressure, both lithostatic and fluid, including P_{H_2O}, P_{CO_2}, P_S and mixed volatile fluids.

588. **Geochemistry.** (3-0) Cr 3 F *Prereq: 540; Chem 321 recommended* Richardson Elemental abundance patterns and geochemical cycles in the earth and oceans. Application of basic thermodynamic and kinetic principles to the study of geochemical processes.

589. **Geochemical Instrumentation.** (0-4) Cr. 2. S. *Prereq: 540.* Richardson. Instrumental methods for the analysis and characterization of earth materials: microprobe, electron microscopy, atomic absorption, nuclear methods, and others.

590. **Special Topics.** Cr 1 to 3 each time taken.

595. **Seminar.** Cr R. F.S. *Prereq. Senior or graduate classification.*

Courses for Graduate Students, Major or Minor

699. **Research.** Cr Var

Meteorology

Courses Primarily for Undergraduate Students

101. **Technical Lectures.** (1-0) Cr R F Introduction to various phases of research and employment in meteorology Required of all meteorology majors.

206. **Introduction to Meteorology.** (Agron 206) (2-0) Cr 2 F S. Introduction to basic meteorological processes The general circulation, solar and terrestrial radiation, fronts, cyclones and anticyclones, weather maps and forecasting

301. **General Meteorology I.** (3-2) Cr 4 S *Prereq Math 165 or 175, Phys 222.* Physical processes in the atmosphere including weather; instruments and observations, thermodynamics of dry and moist air, cloud physics, and radiation balance

302. **General Meteorology II.** (2-3) Cr. 3. F *Prereq: 301.* Fluid processes in the atmosphere including equations of motion, geostrophic and gradient flow, continuity equation, general circulation, concepts of weather map analysis

341. **Atmospheric Thermodynamics and Statics.** (3-0) Cr 3 F *Prereq Math 166 or 176, Phys 222.* Equation of state, first law of thermodynamics, thermodynamics of water vapor, mixtures of gases, stability, hydrostatic equation

342. **Physical Meteorology.** (3-0) Cr 3. S. *Prereq: 341* Basic radiation laws, cloud physics, atmospheric electricity

406. **Climates of the Continents.** (Agron 406) See *Agronomy*

443. **Fluid Processes in the Atmosphere.** (4-0) Cr 4 S *Prereq 341* Development of the governing equations of motion Concepts of divergence, circulation, and vorticity

454, 455. **Synoptic Meterology I, II.** (3-3) (2-6) Cr 4 each yr *Prereq. 454 443, 455. 454. 454* Development of quasigeostrophic theory Numerical prediction methods and linear perturbation theory Applications to midlatitude synoptic systems. 455. Observational studies of tropospheric weather systems ranging in size from mesoscale to the planetary scale Visualization and application of dynamic principles are stressed

490. **Independent Study.** Cr Var. *Prereq: Permission of instructor*

499. **Seminar.** (1-0) Cr 1 F Required of all meteorology seniors Topics in current research are reported and discussed by students

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

505. **Microclimatology.** (Agron 505) See *Agronomy.*

528. **Atmospheric Physics.** (Phys 528) See Physics.

531. **Air Pollution.** (Ch E 531) (3-0) Cr 3. S. *Prereq: Senior or graduate classification in engineering or the physical sciences.* Fundamentals of the formation, dispersion, and affects of air pollutants. Air quality standards, sampling and analysis, introduction to control methods.

542. **Physical Meteorology.** (3-0) Cr. 3 F *Prereq: Math 266.* Propagation of energy through the atmosphere, atmospheric optics, visibility, aerosol physics, radar meteorology

543, 544. **Dynamical Meteorology I, II.** (3-0) Cr. 3 each. Yr. *Prereq: 543: 443; 544: 543.* 543: Governing equations, scale analysis, simple types of wave motion in the atmosphere, instability theory. 544: General circulation and dynamics of zonally symmetric circulations, atmospheric energetics, nonlinear dynamics of planetary waves.

571. **Cloud Physics.** (3-0) Cr. 3. Alt. S. *Prereq: 342 or Phys 304.* Precipitation physics, thermodynamics of phase change and nucleation, condensation nuclei and ice nuclei, diffusional growth of cloud drops and ice crystals, accretional growth of cloud drops and ice particles.

590. **Special Topics.** Cr. Var

Courses for Graduate Students, major or minor

605. Micrometeorology. (3-0) Cr 3 Alt F *Prereq 443* Physical processes in the atmosphere near the ground. laminar and turbulent flow; transfer of heat, mass, and momentum, eddy diffusion; statistical theories of turbulence, wind and temperature profiles near the surface, evaporation

641. Atmospheric Radiation. (3-0) Cr 3 Alt S *Prereq Math 266* Solar and terrestrial radiation, radiative transfer equation, Stokes parameters, polarization

699. Research. Cr Var

Economics

Raymond R Beneke, Chair of Department

Professors: Arthur, Baumel, Beneke, Boehlje, Faden, Fletcher, Fox, Fuller, Futrell, Gratto, Harl, Harris, Heady, Hoyt, James, Kolmer, Ladd, Lapan, Luckett, Merrill, C. W Meyer, Paulsen, Prescott, Scott, Skadberg, Starleaf, Stephenson, Thomas, Timmons, Van de Wetering, Wisner

Emeritus Professors: Davey, Howell, Murray, Ogg, Shepherd, Wright

Associate Professors: J W Adams, R D Adams, Doak, Enders, Gardner, Hammond, Hayenga, Huffman, Mattila, Miranowski, Pounds, Stone, Weisskoff

Assistant Professors: Abrahams, Alt, Calkins, Dahlgran, Deiter, Edwards, Falk, Ginder, Jolly, W H Meyers

Undergraduate Study

The department offers work for the degree Bachelor of Science with major in agricultural business, and for the degrees Bachelor of Science and Bachelor of Arts with major in economics. For further discussion of programs in agricultural business, see the statement under College of Agriculture For programs in economics, see the statement under College of Sciences and Humanities

College of Agriculture

For the undergraduate curriculum in agricultural business, see *College of Agriculture, Curricula*

Students majoring in agricultural business must select one area of specialization from economic analysis, public policy, farm management, agribusiness management, agricultural finance, or agricultural sales and marketing The curriculum prepares students for advanced studies and for careers in farm and ranch operations, commercial farm management and appraisal, agricultural finance, agricultural supply and marketing industries, research for business firms, agricultural reporting and public relations, agricultural extension, and government service.

College of Sciences and Humanities

Candidates for either the Bachelor of Science or the Bachelor of Arts degree with major in economics must fulfill requirements established by the College of Sciences and Humanities. (For details of undergraduate curricula in sciences and humanities, see *Sciences and Humanities, Curriculum)*

Besides fulfilling the group requirements of the College of Sciences and Humanities, the Department of Economics requires for the degree Bachelor of Science the inclusion of Engl 414 in the communication group. Within the mathematical and natural sciences group requirements, the economics major is required to take both Math 150 and 151, or 150, 165, and 166 Math 175 and 176 may be taken instead of 165 and 166, if desired. Also required to be included in the mathematical and natural sciences group for the Bachelor of Science degree in economics is one course in statistics and one course in computer science, each at the appropriate level for economics majors. Within the College of Sciences and Humanities social sciences group, the economics major is not allowed to use any economics courses to fulfill the minimum requirement. Besides these departmental requirements, 27 credits in economics are required for majors in economics For the bachelor of science degree in economics these 27 must include Econ 201, 401, and 402

For the degree Bachelor of Arts, the Department of Economics requires that Engl 414 be included in the communications group Within the mathematical and natural sciences group requirements, the economics major is required to take both Math 150 and 151, or 150, 165, and 166 and one course in statistics at the appropriate level for the student Math 175 and 176 may be taken instead of 165 and 166, if desired The degree Bachelor of Arts in economics should include a broad array of courses outside the Department of Economics in the social sciences group and the arts and humanities group Twenty-seven credits in economics are required for the Bachelor of Arts degree in economics, including Econ 201, 312, 401, and 402.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with majors in economics and agricultural economics, and minor work to students taking major work in other departments

Prerequisite to major work in the department is the completion of undergraduate work in economics, mathematics, statistics, and other social science and technical subjects substantially equivalent to that required of undergraduate students majoring in economics or agricultural business

Candidates for the degree Master of Science are required to complete satisfactorily 30 credits of acceptable graduate work, including preparation of a thesis

With the approval of the program of study committee candidates for the degree Master of Science may fulfill requirements by satisfactorily completing 36 credits of course work, in which case preparation of a thesis is not required

Programs of study for the doctorate are organized by each student in consultation with the major professor and the individual's committee Students may select fields of concentration from the following agricultural marketing and price analysis, agricultural production, finance, and policy; econometrics, economic growth, development, and planning, history of economic thought, industrial organization and regulation, international economics, labor economics; mathematical economics; monetary economics, natural resource economics, public finance, regional-urban economics.

Each student is expected to achieve a minimum competence in economic theory as demonstrated by completing basic and advanced courses in microeconomic and macroeconomic theory and by completing a written qualifying examination Examinations are also required in two other fields selected from the list above. An outside minor, such as statistics, mathematics, or computer science, can be substituted for one of the fields.

Cooperative programs of study may be arranged with the University of Iowa College of Law or with other recognized institutions

The department also cooperates in the interdepartmental programs of Industrial Administrative Sciences, Industrial Relations, Technology and Social Change, Transportation Planning, and Water Resources (See *Index*)

Courses open to graduate students for minor credit only. 401, 402, 404, 405, 406, 410, 411, 421, 430, 435, 436, 445, 446, 447, 451, 455, 461, 465, 480, 495, 496

Courses Primarily for Undergraduate Students

***110. Orientation in Agricultural Business.** (1-0) Cr R F Field of agricultural business

***130. Farm Business Practices.** (2-2) Cr 3 S For two-year and winter programs in farm operation only Farm records and accounting practices for farm and tax management Business and economic principles of decision making Investment decisions in land, improvements and machinery Price considerations for crop and livestock production and marketing

***192. Agribusiness Operations.** (4-0) Cr 4 F S Application of accounting, business management, and economic principles to the operation of agricultural firms Functions of management, financial statements, merchandising, personnel administration, production, marketing, trade, agricultural policy, resources, population Fee for visits to representative agricultural businesses

†201 Principles of Economics. (4-0) Cr 4 F S SS Meaning, purpose, and role of economics, demand and supply, national income and employment, inflation, fiscal and monetary policy, the banking system, pricing and the market system, market structures, international trade, balance of payments, and rates of exchange

†203. Introduction to Principles of Macro-Economics (2-0) Cr 2 F *Prereq Math 165 or 175* Problems of resource allocation, demand and supply, national income, employment, and price levels, fiscal and monetary policy, operation of the banking system elements of international finance

†204 Introduction to Principles of Micro-Economics (2-0) Cr 2 S *Prereq 203* Theories of production and consumption, pricing and the market system, perfect and imperfect competition, business and labor regulation, elements of international trade

250 Public Interest Economics. (2-0) Cr 2 F S *Prereq 201 or 204.* Application of political economy to broad areas of citizen concern. Economic analysis of such issues as energy, ecology, health, corporate responsibility, and consumer protection Students may be required to work in task forces and to participate in one day of manual labor in a community project

304 Money and Banking. (3-0) Cr 3 F S SS *Prereq 201 or 203.* History and theory of banking, market structure of banking, bank management, money and capital markets, nonbank financial institutions, central banking, monetary theory, international monetary arrangements, monetary policy

306. Comparative Economic Systems (3-0) Cr 3 F S *Prereq 201 or 204* Analysis and comparison of alternative economic systems, particularly capitalism democratic partial socialism, market socialism, and command socialism. Contemporary systems examined include those of the United States, France, Sweden, Yugoslavia, Soviet Union, and China. Emphasis on underlying theory, institutions, and selected problems associated with respective economic systems, prospects for institutional change and convergence

312. History of Economic Thought. (3-0) Cr 3 S. *Prereq 201 or 204* History of economic thought as related to the intellectual history of the times Major persons treated include Smith, Ricardo, Marx, Marshall, and Keynes

*330. **Farm Planning, Production and Organization.** (3-2) Cr 4 F S.SS *Prereq: 201 or 204, Acct 284.* Business and economic principles. Management problem identification and solution. Budgeting enterprise and total farm plans. Investment decisions in land, improvements and machinery. Farm business organization and operating arrangements. Adjusting to price and production uncertainty

*335. **Agricultural Marketing.** (3-2) Cr. 4 F.S SS *Prereq 201 or 204* Composition of the agricultural marketing complex, functions performed by marketing agencies, price-making forces for agricultural products, use of market information in forecasting commodity prices, futures markets, speculation, and hedging, alternative marketing methods for major Iowa agricultural commodities Market structures, price and nonprice policies, government regulation Fee for field trips to selected marketing firms and agencies.

*338. **Dairy Marketing.** (2-0) Cr. 2 Alt. F , offered 1982 *Prereq. 201 or 204.* Examination of dairy industry; consumer demand, industry organization and performance; federal milk marketing orders, bargaining cooperatives; pricing systems, promotional efforts

*380. **Natural Resource and Environmental Economics.** (3-0) Cr 3. F.S. *Prereq: 201 or 204.* Natural resource availability, use, conservation, and government policy, including energy issues Environmental quality and pollution control policies.

381, 382. **Economic History Survey.** (Hist 381, 382) See *History*

401. **Prices and Resource Allocation.** (4-0) Cr 4 F S.SS *Prereq: 201 or 204.* Theory of consumer demand and supply behavior of the business firm; competitive and imperfectly competitive markets Theory of the demand for and supply of factors of production General equilibrium analysis and welfare economics.

402. **National Income and Employment.** (3-0) Cr 3. F S.SS *Prereq: 201 or 204.* National income accounting. Static and dynamic theories of the determination of income and employment. Analysis of the economic problems of inflation and unemployment. Monetary and fiscal policies for promoting economic stability and growth.

404. **Labor Economics.** (3-0) Cr 3. F.S.SS. *Prereq: 201 or 204* Survey of contemporary labor market problems and public policy towards labor. Economic analysis of topics such as labor supply and hours of work, work incentives of transfer programs, education and training, mobility, labor demand and employment, minimum wages, unions, income distribution and relative wages, discrimination, unemployment and wage inflation.

405. **Public Finance.** (3-0) Cr 3. F.S.SS. *Prereq: 201 or 204* Economics of public expenditures and taxation; federal, state, and local revenue and expenditure policies; current issues in public finance.

406. **Marxian Economics.** (3-0) Cr 3 F. *Prereq: 201 or 204* Economic theories of Karl Marx, including contributions and criticisms by other scholars. Topics include value, price, and distribution theory, business cycles, alienation of labor, and evolution of economic systems; applications to contemporary economies, including developing nations.

410. **Economics of Antitrust and Regulation.** (3-0) Cr 3 S *Prereq: 201 or 204.* Structure, conduct, and performance of industries. Analysis of American antitrust laws and government regulation of industries.

411. **Economic Development.** (3-0) Cr. 3 F *Prereq: 201 or 204.* Current problems of developing countries, theories of economic development, agriculture and economic development, measurement and prediction of economic performance of developing countries, alternative policies and reforms required for satisfying basic needs of third world countries, interrelationships between industrialized countries and the developing countries.

*421. **Cooperatives.** (2-0) Cr. 2. Alt. F , offered 1981 *Prereq: 201 or 204.* General survey of cooperative activities, with special reference to agriculture; kinds of cooperatives, methods of organization and operation, principles, legal requirements; economic possibilities and limitations of cooperation.

*430. **Advanced Farm Decision-Making.** (3-2) Cr. 4. F.S. *Prereq: 330, 435; 451 recommended.* Effective use of quantitative methods and computer assistance for solving farm problems. Application of economic theory to production problems. Planning to account for changing prices and production and to meet government programs and policies. Using efficiency measures to assess and redirect resource use. Integrating tax management into farm business decision-making. Multi-period production and financial planning

*435. **Agricultural Finance and Investment Analysis.** (4-0) Cr 4 F S *Prereq 201 or 204.* Financial requirements of farm firms. Acquisition of debt and equity funds. Investment and cash flow analysis. Evaluation of credit needs and repayment capacity Appraisal and valuation of real estate Analysis of credit sources including commercial banks, insurance companies, merchants and dealers, Farm Credit System banks, Farmers Home Administration, Small Business Administration, and individuals.

*436. **Agribusiness Firm Analysis.** (3-0) Cr 3 F S. *Prereq. 401, Stat 228.* Introduction to use of economic theory and quantitative techniques in analysis of agribusiness firms; formulation of decision problems, measurement of demand and cost relationships, forecasting techniques.

445. **Collective Bargaining.** (3-0) Cr. 3. S *Prereq: 404.* Economic analysis and institutional aspects of unions and collective bargaining Organizing, bargaining strategy, and contract terms, impact of unions on employment and wages. Public policy toward unions, strikes, and negotiated benefits in both the private and public sectors

446. **Economics of Discrimination.** (WS 446) (2-0) Cr 2 F *Prereq. 201 or 204* Economic theories of discrimination Analysis of the economic problems of women and minorities in such areas as earnings, occupations, and unemployment. Public policy concerning discrimination.

*447. **Agricultural and Rural Policy.** (3-0) Cr 3 F S *Prereq. 201 or 204.* Description and analysis of economic problems of agriculture and rural communities. Explanation and economic analysis of government programs to develop agriculture and rural communities, stabilize and improve farm prices and incomes, plan rural land use, industrialize rural areas, control agricultural pollution, alleviate rural poverty, and regulate foreign trade.

*451. **Agricultural Law.** (3-2) Cr. 4 F.S *Prereq. Senior classification.* The legal framework impinging upon decision making by farm firms, families and individuals. real and personal property, organization of farm firms, intergeneration property transfers, trusts, insurance, liabilities, contracts, secured transactions, negotiable instruments, fence law, tax planning and management, water law, environmental law, federal and state regulatory powers.

455. **International Economics.** (4-0) Cr 4 F.S *Prereq. 201 or 204* Analysis of pattern and benefits of international trade in relationship to employment, factor prices, and growth International cartels, monopolies, and governmental policies toward trade, such as tariffs, quotas, and common markets. Balance of payments deficit, surplus, and exchange rate policies. Analysis of devaluations, international role of gold, Special Drawing Rights (SDR), fixed versus flexible exchange rates, history and reform of the international monetary system

461. **Urban-Regional Economics.** (3-0) Cr 3. F *Prereq: 201 or 204.* Theories of urban development; city typologies, trade and commuting patterns; urban economic interdependence, social investment in metropolitan communities, regional growth and efficiency; locational determinants of firms and households, the regional economic base; resource development and economic planning in the city-region.

465. **Economics of Educational Systems.** (3-0) Cr 3. Alt. S., offered 1982. SS. *Prereq: 201 or 204.* Economic problems of public education including production of services, resource use, allocative techniques among and within school systems, alternative measures of educational value, resource development through school systems.

*480. **Intermediate Natural Resource and Environmental Economics.** (3-0) Cr 3. S. *Prereq: 380, 401.* Theories of natural resource utilization and allocation. Externalities, public goods, and environmental quality. Planning natural resource use and environmental quality. Methodologies for analyzing natural resource and environmental problems.

490. **Independent Study.** Cr. 1 to 5 each time taken. *Prereq: Junior or senior classification, 14 credits in economics.*
*A. Agricultural Economics.
B. Economics.
H. Honors.

*492. **Senior Career Seminar.** (1-0) Cr. 1. F.S. *Prereq: Classification in agricultural business.* Career opportunities in the various agribusiness industries. Required training and skills needed to perform successfully in different types of jobs within industry. Selection and training programs of typical agribusiness firms.

495. **Applied Microeconomics.** (2-0) Cr. 2. F. *Prereq: 401, Stat 401, Math 150.* Study of microeconomic theory, with emphasis on business decision-making and statistical analysis. Consumer demand, cost minimization, pricing, and other strategic behavior.

496. **Applied Macroeconomics.** (2-0) Cr 2. S. *Prereq: 402, Stat 401.* Application of macroeconomic theory to current economic problems. Analysis of economic policy

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*Administered by the College of Agriculture. Courses not marked with an asterisk are administered by the College of Sciences and Humanities.

†Credit for both 201 and 203 or 204 may not be applied toward graduation.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

500. **Introduction to Graduate Studies.** (1-0) Cr. R. F. Orientation course for new graduate students. Course content, ongoing research, and job opportunities in different areas of specialization in economics are discussed by the graduate faculty.

501. **Intermediate Microeconomic Analysis.** (4-0) Cr. 4. F.S. *Prereq: 401.* Economic theory and methodology; theory of consumer behavior; theory of competitive firm; partial equilibrium analysis and comparative statics; general equilibrium, economic efficiency and welfare; theory of imperfect competition.

503. **Intermediate Macroeconomic Analysis.** (3-0) Cr. 3. F S. *Prereq: 402.* National income accounting, price indices, and the measurement of unemployment. Examination of the postulates and policy implications of the classical, neo-classical, Keynesian, and neo-Keynesian models of aggregate economic activity. Causes and consequences of price inflation.

504. **Quantitative Methods in Economic Analysis.** (4-0) Cr 1 F *Prereq: 401.* Economic applications of selected concepts of finite mathematics, differential calculus with emphasis on optimization, and integral calculus.

*512. **Agrarian Reform and Economic Development.** (3-0) Cr 3. Alt. S., offered 1983. *Prereq: 501.* Nature of agrarian institutions in obstructing and in achieving economic growth, income distribution and employment within developing countries. Improvements in factor and product markets, credit, ownership and tenancy systems, labor arrangements, inheritance systems, water rights and allocation, land measurement and titles, and other agrarian institutions through country, regional, intercountry, and United Nations actions. Comparative analysis of these institutions within countries; transfer and adaptation to other countries.

515. **Industrial Organization Theory.** (3-0) Cr. 3. Alt. F., offered 1982. *Prereq: 401.* Theory and empirical studies of industrial structures and market practices in the American economy; measurement and evaluation of competition and monopoly.

516. **Economic Aspects of Antitrust and Trade Regulation.** (3-0) Cr. 3. Alt. S., offered 1983. *Prereq: 515.* Legal manifestations of national economic antitrust and trade regulation policy; public intervention in industrial organization and price output policy; exemptions from antitrust law; price control; market divisions and agreements not to complete; refusals to deal; monopoly; merger; resale price maintenance; discrimination in distribution; unfair trade practices; remedies under antitrust law; effectiveness of antitrust policy.

*520. **Human Capital Formation in Rural Areas.** (3-0) Cr. 3. Alt. S., offered 1983. *Prereq: 501.* Nature and process of human capital formation in households, firms and public institutions; labor supply and time allocation; application of benefit-cost analysis to human investments in agriculture; private and public costs and benefits of educational, health and mobility investments in rural people; distribution of human investment costs and benefits; demands for and capacity to provide human investment resources and facilities in rural areas.

*530. **Applications of Mathematical Programming in Agriculture.** (2-0) Cr. 2. F. *Prereq: 430.* Techniques of building and solving linear programming models of agricultural problems; model building, solving problems with MPSX, and interpreting the solutions. Applications of interregional competition models and multigoal, integer, separable, and quadratic programming procedures.

*531. **Agricultural Marketing Principles.** (3-0) Cr. 3. F. *Prereq: Credit or classification in 501.* Marketing firm choices concerning input acquisition, production, marketing, and plant location. Roles and impacts of

market structures, information, grading, alternative coordination and ownership arrangements, futures markets, government regulation.

***532. Quantitative Research and Decision Models.** (3-0) Cr. 3 S *Prereq: 501, credit or classification in Stat 401* Use of statistical, economic, and other social science models to study marketing problems. Applications to public and private decision making.

***535. Economic Development and Transformation of Agriculture in Developing Countries.** (3-0) Cr 3 Alt. S., offered 1982. *Prereq: 501.* Role of agriculture in economic development, relation of agricultural development to factor prices, firm structure and technology; role of government policies, firm behavior, and aggregate food response, improvement and communication of technology; capital supplies, resource problems under various developmental stages, equity problems.

536. Dynamic Economic Analysis. (3-0) Cr 3 S *Prereq: 501, 503.* Fundamentals of dynamic economy theory, difference and differential equations and stability analysis, with emphasis on applications to macro and microeconomic theory; equilibrium and disequilibrium systems Dynamic optimization techniques and applications to economic theory

537. Linear and Nonlinear Economic Models. (3-0) Cr 3. F *Prereq. 401, 504* Linear and nonlinear programming, input-output analysis, game theory, Markov chains, dynamic programming and other applied mathematical models in economics

538. Econometric Statistics. (Stat 538) See *Statistics*

539. Game Theory. (Stat 539) See *Statistics*

544. Theory of Public Goods and Externalities. (3-0) Cr 3 F *Prereq: 501* Public goods, externalities, theory of income redistribution, public choice

545. Economics of Taxation. (3-0) Cr 3 S *Prereq 501* Partial and general equilibrium analysis of tax shifting and incidence, excess burden and effects of taxes on supplies of labor, capital, and risk-taking, alternate bases for taxation and concepts of equity, optimal taxation, economic effects of personal and corporate income taxes, payroll taxes, sales taxes, wealth and property taxes, the burden of debt, fiscal federalism

***548. Agricultural Price Analysis.** (3-0) Cr 3 Alt S., offered 1983 *Prereq. 401, credit or classification in Stat 405* Measurement of supply and demand of agricultural products Use of forecasts in public and private decision-making

551. Monetary Theory. (3-0) Cr 3 F *Prereq 503* The monetary mechanism neoquantity theory. neo-Keynesian monetary theory and the portfolio approach, microeconomic aspects of monetary theory including monetary determinants of cost of capital Rate of interest, expectations, and lag in effect of monetary policy Money supply theory

552 Advanced Money and Banking. (3-0) Cr 3 S *Prereq 503* Advanced topics in monetary economics, including monopoly and competition in banking, models of commercial bank behavior, term structure of interest rates, instruments of monetary control, debt management, effectiveness of monetary policy

555. International Trade. (3-0) Cr 3 F *Prereq. 501* Modern theory of international trade, welfare and distributional aspects of trade and tariffs The interdependence of international trade and economic growth. Optimal trade policies in the presence of such distortions as unemployment, monopolies and cartels, balance of payments problams, infant industries, and common market areas

557. International Finance. (3-0) Cr 3. S. *Prereq 503* Theory of foreign exchange, mechanisms of adjustment to balance of payments problems such as devaluations, monetary and fiscal policies, and exchange controls, international dependencies between domestic economies. Exchange speculation, evolution of the international monetary system, capital movements, the phenomenon of international inflation.

***561. Agricultural Resource and Income Problems.** (3-0) Cr 3. F *Prereq 501* Resource and income problems of U.S. and foreign agriculture. Forces for disequilibria, adjustment, instability, low and unequal resource productivity, poverty, income inequality, malnutrition, and international trade.

***562. Agricultural and Food Policies and Programs.** (3-0) Cr 3. S *Prereq: 561* Description, analysis, and evaluation of domestic and international policies and programs influencing agricultural resource productivity and allocation; farm product, food and input prices, income distribution, world food situation, international trade in agricultural commodities.

565. Location and Regional Theory. (3-0) Cr 3 Alt. S., offered 1982 *Prereq. 501, 504* Location of plants, industries and communities, network flows, spatial programming and optimization, regional input-output, spatial competition, land markets, influence of topography and resource distribution, innovation diffusion

566. Regional-Urban Economics. (3-0) Cr 3 Alt F., offered 1982 *Prereq: 501* Theories of city growth, regional development models, central places and urban hierarchies, migration and commuting, city layout, CBD functions, problems of transportation, congestion, pollution and housing, public services

568. Evaluation of Development Projects. (3-0) Cr 3 Alt S., offered 1983 *Prereq: 501* Review of standards for the planning and evaluation of natural resource and related development projects. traditional practices and recent innovations, economic and financial analysis. traditional investment criteria, project selection and investment programs, investment criteria for economic development, determination of the social discount rate, relation between classical welfare economics and cost-benefit analysis, treatment of externalities, secondary benefits and intangibles, traditional approaches to the valuation of labor, capital and foreign exchange, models of optimal economic growth and determination of national project evaluation parameters, integration of efficiency and equity into project selection, derivation and estimation of shadow prices, relationship between economic planning and the analysis of development projects.

573. Applied Econometric Models. (4-0) Cr 4 F *Prereq Stat 405* Selected applications of econometric techniques to models of consumer behavior, cost and production, demand for factors of production, the financial sector, and macroeconometric models Selected topics of econometric problems encountered in applied econometric research

575. Bayesian Econometrics. (3-0) Cr 3 F Offered twice every three years, offered 1981 *Prereq. Stat 447* Difficulties with orthodox procedures, foundations of Bayesian inference, parameter estimation and forecasting, Bayesian and post-Bayesian hypothesis testing, regression models, simultaneous equations, Bayesian control models

***579 Water Resources III.** (WR579) (3-0) Cr 3 S *Prereq Permission of water resources supervisory committee* Water resources planning Water management categories and beneficial use groups, water demands for various uses Legal, economic, sociological, governmental and technical aspects of water resources planning and management Emphasis on systems of rational allocation among competing demands for water Administered by Economics, in cooperation with Political Science and Sociology

580, 581. Economic Development and Planning. (3-0) Cr 3 each Alt yr., offered 1981-82 *Prereq: 580. 501, 503, 581 580* 580 Performance of developing countries in terms of output, equity and stability criteria, survey of theories and approaches to economic development, determinants of development, growth, value, and price in the labor surplus economy; choice of technique and technological change, sectoral balance and development strategies 581 Planning models in relation to contemporary issues in economic development, techniques for sectoral analysis and planning, policy instruments and the evaluation of policy alternatives, organization and utilization of national and sectoral planning systems, applications to national, sectoral, and regional development problems.

585. Comparative Economic Systems. (3-0) Cr 3 Alt F., offered 1981 *Prereq 501, 503* Analysis and comparison of economic theories, institutions, policies, and performance of alternative contemporary economic systems, emphasis on the economies of the Soviet Union, China, and Yugoslavia

590. Special Topics. Cr 1 to 5 each time taken
*A Agricultural Economics
B Economics

595. Law of Labor Relations. (3-0) Cr 3 F *Prereq 445* Federal and state legislation and policies affecting the collective bargaining process, wages, and employment

596. Labor Markets. (3-0) Cr 3 Alt F., offered 1982 *Prereq 501* Modern analysis of labor demand and market determination of wages and employment; analysis of distortions in labor markets due to non-competitive forces, legislation, and discrimination, microeconomic analysis of unemployment and job search

Courses for Graduate Students, major or minor

601. Advanced Microeconomic Analysis. (3-0) Cr 3 F S *Prereq 501* Advanced topics in consumer theory: compensating and equivalent variations, indirect utility functions, analysis of consumer and producer behavior under uncertainty; axiomatic approach to general equilibrium theory Welfare analysis: compensation principles, theory of the second best. Intertemporal resource allocation, consumer and producer behavior

603 Advanced Macroeconomic Analysis. (3-0) Cr 3 S *Prereq: 503* Post-Keynesian consumption function hypotheses Capital theory and the determinants of investment The demand and supply of money Stabilization policies Models of long-term economic growth

605, 606. History of Economic Thought. (3-0) Cr 3 each Alt yr., offered 1982-83 *Prereq 501, 503* Principal figures in the development of economic ideas, contribution of each period of economic thought 605 The Mercantilists to the Classical School, inclusive 606 Critics of the Classical School to J. M. Keynes

614, 615. Advanced Theoretical Models. (3-0) Cr 3 each 614, Alt S., offered 1982. 615, Alt. F., offered 1982 *Prereq 501, 504* Selected topics in economic theory, decision-making under uncertainty, control theory, social choice theory, and measure theory Economic applications optimal growth under uncertainty, costly resource adjustment, optimal income distribution, and rational expectations Introduction to the advanced literature, including relevant models from other social sciences

***635. Theory and Concepts of Agricultural Finance.** (3-0) Cr 3 F *Prereq. 501* Concepts of farm financial management and investment analysis discounting techniques, capitalization theories, risk and diversification Economic analysis of the capital market for agriculture supply of and demand for debt and equity funds, processes of financial intermediation

***641. Economics of Agricultural Production and Resource Allocation.** (4-0) Cr 4 S *Prereq 501* Production principles applied to agricultural labor, capital and natural resources, uncertainty and decision models, farm size, cost and productivity; commodity supply and resource demand, location and interregional competition, programming, simulation and other planning models, technological change, efficiency of agricultural production, macro and policy aspects

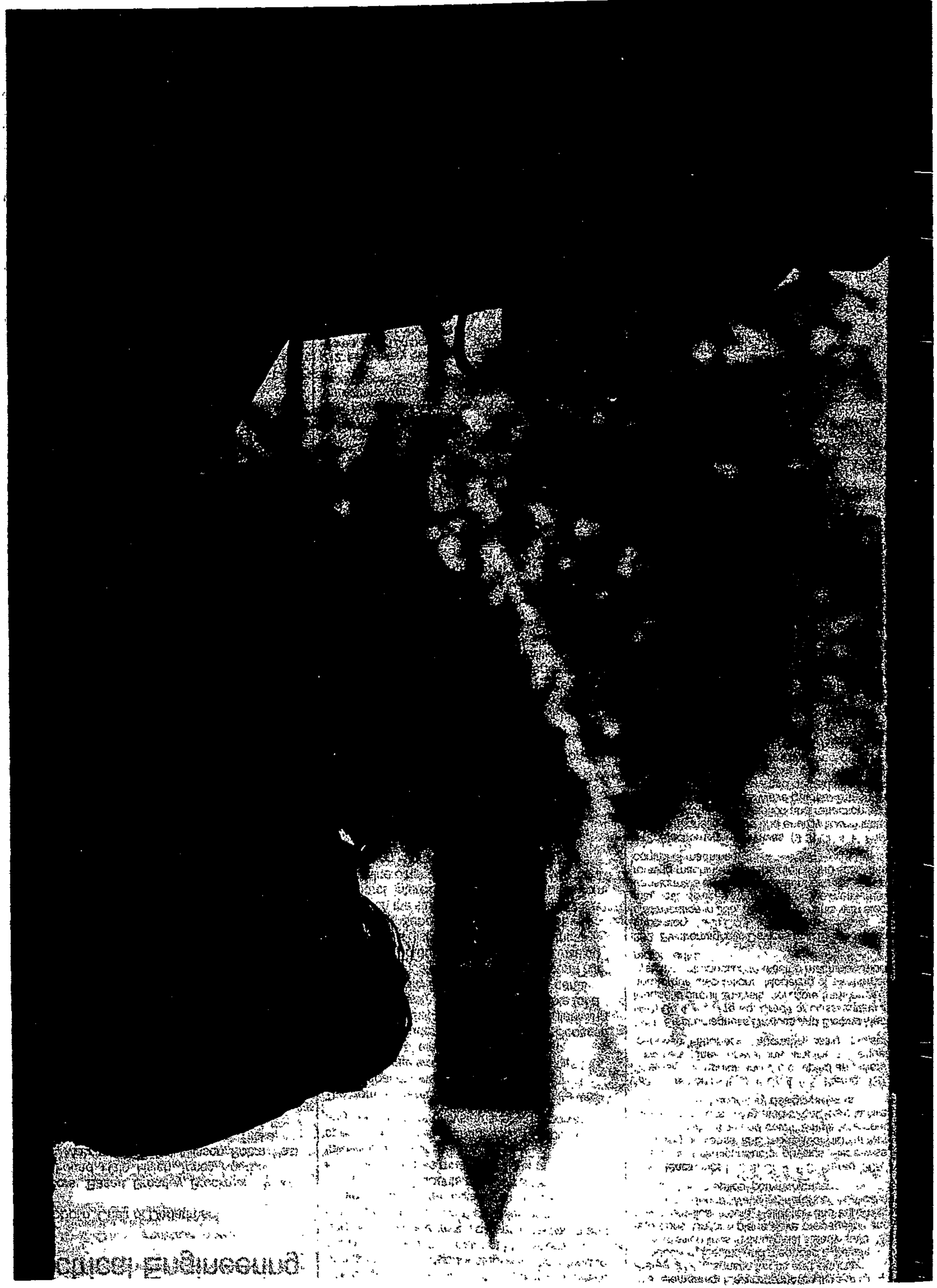
651 Time Series. (Stat 651) See *Statistics*

***680, 681. Advanced Natural Resource and Environmental Economics.** (3-0) Cr 3 each Yr *Prereq 680 501, 681 680* 680: Nature, objectives, and problems of natural resource utilization and environmental quality Economic, physical, and institutional interrelationships Characteristics, criteria, and classes of natural resources Interrelationships of natural resources and the environment with emphasis on capability of natural resources to absorb effects of environmental change Demand for and supply of natural resources Market and nonmarket considerations Technological change Private versus social decisions 681: Quantification of decisions in managing natural resources and environmental quality Objective functions, social costs and benefits, and intertemporal allocation. Policy analysis and evaluation for natural resource use and environmental quality; local, state, regional, national, and international levels, current and socially optimal policies, legal and social constraints

690. Seminar. Cr 1 to 3 each time taken *Prereq 6 graduate credits in chosen field* Offerings each semester will be selected from the following list
A Industrial Organization
B International Economics
C Economic Development
D Monetary Economics
E Public Finance
F Urban-Regional Economics
*G Agricultural Marketing and Price Analysis
*H Agricultural Development
I Labor Economics

699. Research.
*A. Agricultural Economics
B. Economics

***Administered by the College of Agriculture. Courses not marked by an asterisk are administered by the College of Sciences and Humanities.**



Electrical Engineering

J. O. Kopplin, Chair of Department

Professors: Basart, Brearley, Brockman, Brown, Camp, Fouad, Hale, Hsieh, Jones, Koerber, Kopplin, Mahmoud, Michel, Nilsson, Pohm, Post, Potter, Read, Smay, Swift, Townsend, Triska, Willett, Zingg

Emeritus Professor: Boast

Associate Professors: Baker, Bond, Carlson, Coady, Comstock, Fanslow, Horton, Kruempel, McMechan, Mericle, Musil, Piatkowski, Samuels, Scott, Stephenson

Assistant Professors: Anderson, Bums, Cowan, Day, Lacey, Mamandur, Pavlat, Thowsen

Instructor: Crow

Undergraduate Study

For undergraduate curriculum in electrical engineering leading to the degree Bachelor of Science, see *College of Engineering, Curricula*. The department also administers an undergraduate curriculum leading to the degree Bachelor of Science in computer engineering, which is described in *College of Engineering, Curricula*.

Electrical engineers engage in research, development, design, application, management, and sales in electrical and associated industries. They apply the theories, circuits, and materials of electrical engineering toward improvements in all of the range of electrical devices, methods, and systems that render a service to society.

The curriculum in electrical engineering has been designed to enable the individual to develop his or her imagination and knowledge in order to enter any of these fields according to individual incentives, initiatives, and talents.

The department offers a cooperative education program that combines classroom learning at the University with practical engineering experience in industry. Students in this five-year program complete the regular curriculum requirements for the Bachelor of Science degree and acquire carefully planned and supervised work experience at one of the cooperating companies. The first contact with industry comes after the sophomore year. See *College of Engineering, Cooperative Programs*.

Courses for students who are not in the electrical engineering program: 441, 445, 447, 449. Credit in these courses may not be counted toward a degree in either electrical engineering or computer engineering.

Credit for only one member of each of the following pairs of courses or course sequences may be counted toward graduation: 205/206 and 441; 330/331 and 445; 351 and 447; 436 and 437.

Graduate Study

The department offers work for the degrees Master of Science, Master of Engineering, and Doctor of Philosophy with major in electrical engineering and minor work to students taking major work in other departments. Minor work for electrical engineering majors is usually selected from a wide range of courses outside the Electrical Engineering Department. The department also participates in the Technology and Social Change and Energy Systems Engineering interdepartmental minors.

The degree Master of Science requires a thesis and is recommended for students who intend to continue toward the Doctor of Philosophy degree or to undertake a career in research and development. The non-thesis Master of Engineering degree requires an independent study project. Students pursuing a Doctor of Philosophy degree must select one of the following areas of specialization: electromagnetics, computer engineering, control systems, electric power

The normal prerequisite to major graduate work in electrical engineering is the completion of undergraduate work substantially equivalent to that required of electrical or computer engineering students at this University. Because of the diversification in the electrical engineering graduate program, however, it is possible for a student to qualify for graduate study in certain areas of electrical engineering even though his or her undergraduate or prior graduate training has been in a discipline other than electrical engineering. Supporting work, if required, will depend on the student's background and area of research interest. A prospective student from a discipline other than a curriculum in electrical engineering is urged to submit, with the application for admission, a statement of the proposed area of graduate study.

The department requires submission of GRE aptitude test scores by applicants from other countries. All students whose first language is not English must submit TOEFL examination scores.

Interdisciplinary programs between electrical engineering and biomedical engineering are provided jointly under sponsorship by the College of Engineering and the College of Veterinary Medicine. Laboratory facilities are available at the College of Veterinary Medicine, South Campus (See *Biomedical Engineering*.)

Open to graduate students for minor credit only: 309, 313, 330, 331, 351, 352, 412, 413, 416, 421, 422, 423, 433, 434, 435, 436, 437, 441, 445, 447, 450, 451, 456, 457, 474, 475, 476.

Courses Primarily for Undergraduate Students

205. Electric Circuits I. (3-0) Cr 3 F S SS *Prereq. Math 166 or 176 Phys 221* Resistive circuits, single time constant transients, sinusoidal analysis, resonance, mutual coupling, operational amplifiers

***206. Electric Circuits II.** (3-0) Cr 3 F S.SS *Prereq 205* Transformers, polyphase circuits, 2-port networks, Fourier series, Laplace transforms in circuit analysis.

212. Elementary Electromagnetics I. (3-0) Cr. 3. F.S. *Prereq 205.* Lumped-circuit, distributed-circuit, and field models of physical systems for electrical energy transmission. Transient signals on transmission lines and application to digital signal transmission. Introduction to electric and magnetic field theory. Laplace's and Poisson's equations; numerical solutions.

235. Electrical Instrumentation and Experimentation. (1-2) Cr. 2. F.S.SS. *Prereq: Credit or classification in 205 or Cpr E 340.* Electrical components and safety Systems for measurement of voltage, current, power, impedance, and time. Elements of experiment design and techniques for prediction and evaluation of experimental results.

298, 398, 498. Cooperative Education. Required of all cooperative students. *Prereq: Permission of department head.* 298. Work periods for students with sophomore standing in a regularly established cooperative program. 398. Work periods for juniors. 498. Work periods for seniors. Students must register for these courses prior to commencing each work period.

309. Electric Network Design. (2-2) Cr 3. *Prereq: 206, 235.* Graphs and properties of gain and phase functions. Characteristics of tabulated filters. Scaling and transformations. Active network design. Elements of passive synthesis. All-pass networks.

313. Elementary Electromagnetics II. (4-0) Cr 4 F S. *Prereq: 212* Magnetic forces and induction Conduction Electric and magnetic materials Transmission lines in sinusoidal steady-state Maxwell's equations. Uniform plane wave propagation and power flow in physical media. Reflection and transmission at normal incidence Wave interference Applications Introduction to optical communication

***330. Electronics I.** (3-3) Cr 4 F S. *Prereq: 205, 235.* Overview of semiconductor physics. Piece-wise linear modeling of diodes D-C models for bipolar transistor and FET Saturation and cutoff Single time-constant switching circuits Integrated circuit logic families Comparators Laboratory design projects

***331. Electronics II.** (3-3) Cr 4 F S *Prereq. 330.* Small-signal models and a-c coupled amplifiers Power amplifiers Linear operational amplifiers Frequency response Feedback. Laboratory design projects

***351. Electromagnetic Devices and Electric Machinery.** (4-0) Cr 4. F S. *Prereq: Credit or classification in 313* Magnetic circuit analysis Iron core transformers Force and torque calculations Modeling of electromechanical systems Introduction to electric machines Modern motor control

352. Electromagnetic Devices and Electric Machinery Laboratory. (0-3) Cr 1 F S *Prereq: Credit or classification in 235, 351.* Experiments with electric and magnetic devices: force and torque measurements, transformers and their equivalent circuits, electric rotating machines, and the digital and solid state control of machines

412. Electromagnetic Waves. (3-3) Cr 4 F *Prereq. 313* Electromagnetic waves and energy flow in isotropic and anisotropic media. Reflection and refraction at normal and oblique incidence Wave guides. Transmission-line models for uniform-plane and guided waves. Phase and group velocities, dispersion, and the ω-β diagram Wave polarization. Principles of diffraction and applications to radiating apertures, Fourier optics systems, and synthetic aperture radar

413. Transmission Lines and Microwave Engineering. (3-3) Cr 4. S. *Prereq: 412* Common microwave transmission lines Impedance matching. Passive microwave structures. RF amplifier design. Microwave detectors and mixers Microwave sources. Waveguide hardware.

416. Antenna Engineering and Radiowave Propagation. (3-3) Cr 4 *Prereq: 412* Radiation from elementary and extended current sources; wire antennas. Antenna theorems. Scattering Receiving antenna and noise considerations. Array theory and design Aperture antennas. Propagation fundamentals in point-to-point, radar, and scatter systems Free-space, ground-wave, and ionospheric propagation, the atmosphere and noise, from VLF through millimeter wavelengths Techniques and instrumentation for experimental studies.

421. Communication Systems I. (3-0) Cr 3 F *Prereq 309.* Frequency domain analysis. Linear modulation: signals, receivers, transmitters Frequency division multiplex. Angle modulation systems Calculation of signal-to-noise ratios. System comparisons

422. Communication Systems II. (3-0) Cr 3. S *Prereq: 421 and credit or classification in 423.* Sampling theorem and sampling practice. Pulse modulation systems. Quantization and pulse-code modulation Time division multiplex Information theory Data transmission: spectral shaping, transmission impairments, and error rates. Comparison of modulation schemes for data transmission

423. Communication Systems Laboratory. (0-3) Cr 1 F *Prereq: Credit or classification in 421.* Construction and evaluation of modulators, demodulators, and other components for analog and digital communication. Design and evaluation of a simple communication system.

433. Industrial Electronics. (2-0) Cr. 2 *Prereq: 331.* Use of thyristors and triacs in power control. The ideal thyristor in phase-control and zero-voltage switching Applications to stabilized rectifiers, control of d-c and universal motors. Properties of real SCR's and triacs. Circuit protection.

434, 435. Analog Integrated Circuits. (3-3) Cr. 4 each. Yr. *Prereq: 434: 331; 435: 434.* Integrated circuit technology and its effect on circuit design. Internal stabilization. Operational amplifiers. A/D and D/A converters. Multistage amplifiers: frequency response, feedback, stability. Noise. Selected applications.

***436. Digital Integrated Circuits.** (3-3) Cr. 4. F.S. *Prereq. 330, Cpr E 280.* Modern logic families: comparison of

the various technologies as to fabrication constraints, speed, and power. Integrated circuit memories. Design and implementation of digital logic systems and interfaces.

*437 **Digital Integrated Circuits.** (3-0) Cr. 3. S *Prereq: 330, Cpr E 280.* Integrated circuit fabrication principles, constraints on speed and power. Integrated circuit memories. Design of digital logic systems and interfaces.

*441. **Introduction to Circuits, Instruments, and Electronics.** (3-2) Cr 4 F S.SS *Prereq: Phys 222, Math 266 or 267* Circuit analysis using network theorems and Laplace transform techniques Transient and sinusoidal steady-state circuit behavior Resonance Semiconductor materials Diodes. Transistor amplifiers. Operational amplifiers.

*445 **Electronic Circuits, Instruments, and Systems.** (2-3) Cr 3 S *Prereq: 441* Rectifiers and filters BJT amplifiers Field effect transistors. Differential and d-c amplifiers IC fabrication. Bode plots. Feedback. Introduction to digital circuits.

*447 **Introduction to Electric Machinery.** (1-3) Cr 2 *Prereq 441* Magnetic circuits Power transformers Three phase circuit analysis. Basic principles of operation, design, and control of d-c, induction, synchronous, and single-phase machines

*449 **Electrical Theory and Applications.** (2-3) Cr 3 *Prereq Phys 222.* Single- and three-phase circuit analysis Motor fundamentals, controls, and applications Residential, commercial, and industrial electrical systems.

450 **Energy Systems.** (2-0) Cr 2 F *Prereq Senior classification in engineering.* Energy resources U S and world energy supply and demand Electric energy systems organization, structure, and operation Economics of electrical generation Environmental impact of energy systems

451. **Electrical Energy Sources.** (2-0) Cr. 2. S *Prereq Senior classification in engineering* A study of direct energy conversion devices and electrical energy storage methods with emphasis on their utilization in solar electric systems

456. **Power System Analysis I.** (3-0) Cr 3 F *Prereq Credit or classification in 351* Power transmission lines, network analysis, power system representation, load flow

457. **Power System Analysis II.** (2-2) Cr 3 S *Prereq 456* Power system operation, symmetrical components, faults, stability

474 **Linear Systems Analysis.** (3-0) Cr 3. F *Prereq Math 267, one course in circuits.* Writing equations for linear electrical and mechanical systems. State-space formulation. Solution of differential equations by transform methods. Block diagrams and signal-flow graphs. Feedback system characteristics Root-locus, Bode, and Nyquist plots and their relationship to system stability Analysis using Linear Systems Analysis Program

475. **Design of Linear Control Systems.** (3-0) Cr 3 S *Prereq 474.* Z-transform and its relation to Laplace transform Block diagram algebra for sampled systems Time response of sampled systems. Root-locus in the z-plane Sampled-data analysis using Linear Systems Analysis Program. Computation in both continuous and sampled-data systems. Design projects.

476. **Introduction to Analog Simulation and Computation.** (1-3) Cr 2 *Prereq: Math 267.* Basic concepts of analog computing. Time and amplitude scaling. Repetitive operation Optimization. Applications to feedback systems.

490. **Independent Study.** Cr arr *Prereq. Senior classification in electrical engineering.* Investigation of an approved topic commensurate with the student's prerequisites.
H Honors.

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*See material above course listing for credit restrictions.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

503. **Advanced Network Theory.** (3-0) Cr 3. Alt. F *Prereq: 206.* Graph theory and applications to network analysis. Matrix methods applied to multiport networks. State equations and methods of solution. Introduction to discrete time systems.

504. **Network Synthesis.** (3-0) Cr 3 Alt S *Prereq 309 or 503* Properties of passive networks. Passive network synthesis. Properties of networks containing linear active elements Synthesis of active networks with emphasis on two-ports

510. **Topics in Electromagnetics** Cr 1 to 3 F S *Prereq Permission of instructor*
A. Antennas
B Electromagnetic theory
C Microwave engineering
D Radio astronomy
E Contemporary topics

511. **Modern Engineering Optics.** (3-0) Cr 3 each topic *Prereq 412* Each time offered, primary emphasis will be on one of the following topics.
A. Stimulated emission devices and systems masers, lasers, and applications
B Fourier optics and holography
C Optical and hybrid optical-digital computers

512. **Advanced Electromagnetic Field Theory I.** (3-0) Cr 3 F *Prereq. 313.* Static electric and magnetic fields Solutions of static field problems Maxwell's equations Circuit concepts and impedance elements Propagation and reflection of plane waves in isotropic media. Guided electromagnetic waves Characteristics of common waveguides and transmission lines Propagation in anisotropic media.

513. **Advanced Electromagnetic Field Theory II.** (3-0) Cr 3 S *Prereq 512* Special theorems and concepts Plane wave functions Cylindrical wave functions Spherical wave functions Perturbational and variational techniques

515. **Physical Processes in Plasma.** (3-0) Cr 3 *Prereq 313, Phys 325* Ionization processes Behavior of charged particles in electromagnetic fields Self-sustaining processes Breakdown, glow, arc, and corona Plasma Collision theory and Debye shielding Liouville theorem and Boltzmann equation. Diffusion and mobility of weakly ionized gas. Plasma oscillations and waves Diagnostics via Langmuir probe and electromagnetic waves Thermionic and plasma diodes MHD, plasma confinement

516. **Wave Phenomena in Plasma.** (3-0) Cr 3 *Prereq 412, Phys 325* Classification and propagation of waves in plasma Waves in anisotropic magneto-plasma Waves in a bounded plasma. Faraday rotation Wave instability (convective vs nonconvective) Nonlinear oscillations Power flow and energy density Interaction of electromagnetic waves with gaseous and solid-state plasmas Plasma heating Plasma-laser interaction. Instability in semiconductor plasma Applications to semiconductor devices

516. **Radio Astronomy and Astrophysics.** (Astro 518) (3-0) Cr 3 *Prereq 313* or *Phys 365* Radio astronomy fundamentals Wave polarization and measurement Radio telescope receivers and antennas Wave propagation in plasmas Synchrotron emission Continuum and line spectra. Physical conditions in radio sources

521. **Random Signals and Noise.** (3-0) Cr 3. F *Prereq 474* Elementary notions of probability Random variables. Random processes. Gaussian random processes Autocorrelation and spectral functions Estimation of spectrum from finite data Response of linear systems to random inputs Wiener filter theory and extension to finite-data filters.

527. **Statistical Communication Theory.** (3-0) Cr 3. *Prereq: 521* Information theory of Shannon Entropy Noiseless coding Channel capacity Elementary error-correcting codes Continuous channels Hypothesis testing Bayes and mini-max criterion. Detection of known signals. Matched filters Quadrature receiver and equivalent forms Detection of signals in colored Gaussian noise

537. **Semiconductor Device Theory and Technology I.** (3-0) Cr 3 *Prereq: 331, Phys 325.* Structure of solids Wave mechanics. Band theory of solids. Semiconductors and semiconductor devices. Thermionic emission Photoemission Secondary emission. Photoconductivity Luminescence.

538. **Semiconductor Device Theory and Technology II.** (3-0) Cr 3 *Prereq:* 537. Metal-semiconductor diodes. P-N junction diodes. Junction transistors. Field effect transistors. Other semiconductor devices. Integrated circuit fabrication.

543. **Energy Systems Engineering.** (M E 543, Nuc E 543) (2-0) Cr. 2. *Prereq. One course in thermodynamics, E E 441, Econ 201 or 203 or I E 304* Potentials and limitations of energy sources. Energy conversion, utilization, and conservation in industrial, residential, and transportation systems. Energy-related economic, environmental, social, and political considerations.

550. **Advanced Electric Machinery.** (3-0) Cr. 3. Alt. yr. *Prereq. 351, 352* Analysis of machine transients. Modeling and control of multiphase and single-phase machines.

551. **Operation and Control of Power Systems.** (3-0) Cr. 3 Alt Yr *Prereq: 457* Automatic generation control: load frequency control, economic dispatch. Constrained dispatch of real power. Reactive power dispatch. System monitoring.

552. **Advanced Symmetrical Components.** (3-0) Cr 3 F *Prereq. 457.* Computation of phase and sequence impedances of lines, machines, and transformers. Application of symmetrical components.

553. **High Voltage Engineering.** (3-0) Cr. 3. *Prereq: 457* Basics of HV, EHV, and UHV transmission systems, line charecteristics, configuration of conductors, high fields, ionization, AC and DC corona, voltage transients, lightning and protection, insulation coordination, circuit interruption, radio and TV interference

554. **Power System Dynamics.** (3-0) Cr. 3. *Prereq: 457, 474* Dynamic performance of power systems with emphasis on stability Modeling of system components and control equipment. Analysis of the dynamic behavior of the system in response to small and large disturbances

555. **Analysis of Distribution Systems.** (3-0) Cr. 3. *Prereq. 457* Distribution components, design criteria, secondary networks, voltage control, protective device coordination, reliability analyses, load management and automation

556. **Computer Applications in Power Systems.** (3-0) Cr 3 Alt Yr *Prereq 457* Computer algorithms and methods for load flow, fault and stability analysis. On-line computing for power system operation

557. **Power System Protection.** (2-3) Cr 3 Alt. Yr *Prereq 552* Elements of protective systems, relays and relaying schemes, circuit interrupting devices. Laboratory techniques and instrumentation for applications and experimental studies.

570. **Systems Engineering Analysis.** (3-0) Cr 3. *Prereq Credit or classification in Math 415.* Applications of selected topics in abstract algebra, linear algebra, theory of measure and integration, functional analysis, ordinary differential equations, optimization methods, and random processes in the areas of control and communication theory

576. **Discrete Time Control Systems.** (3-0) Cr 3 *Prereq 474* Operational and state-space methods applied to the analysis of discrete-time control systems. Compensation techniques Analysis of nonlinear discrete-time systems. Optimization of discrete systems

577. **Modern Control Systems I.** (3-0) Cr 3. F *Prereq. 474* State variable and input-output description of linear continuous-time and discrete-time systems. Solution of linear dynamical equations. Controllability and observability of linear dynamical systems Canonical descriptions of linear equations. Irreducible realizations of rational transfer function matrices. Canonical-form dynamical equations. State feedback. State estimators. Decoupling by state feedback. Design of feedback systems.

578. **Modern Control Systems II.** (3-0) Cr. 3. S. *Prereq: 577* Nonlinear control systems. Lyapunov stability, Lagrange stability and input-output stability of continuous-time and discrete-time systems. Absolute stability, Popov criterion, and circle criterion. Estimates of trajectory behavior. Stability of large scale systems.

580. **Contemporary Computer Networking and Data Communications.** (3-0) Cr. 3. F. *Prereq: Graduate standing in electrical engineering, computer engineering, or computer science.* Survey of contemporary concepts, facilities, practices and issues in computer networking and data communications. Examples, network types, transmission technology, packet switching, routing protocols, flow control, security, network administration, performance and cost, reliability, social and legal considerations.

581. **Design and Specification of Distributed Processing Systems.** (3-0) Cr. 3. S. *Prereq: Cpr E 483.* Introduction to formal state-oriented techniques for the specification and analysis of digital communication and distributed data processing systems. Protocol validation and direct implementation techniques. System design based on hierarchical layering, canonical structure and canonical function.

582. **Computer System Performance.** (3-0) Cr. 3. *Prereq: 580 or Cpr E 385.* Introduction to measurement,

simulation, queueing and probability theory techniques applied to quantify the performance and realiability of computer systems and networks

583. Advanced Switching Theory. (3-0) Cr 3 *Prereq: Cpr E 483.* Advanced topics in switching theory

584. Digital System Organization. (Com S 584) (3-0) Cr 3. *Prereq. Cpr E 384 or Com S 501.* Influence of processing requirements on digital system structure. Elements of information theory Error detection and correction. Digital systems communications principles, including selected examples (Unibus, IEEE-488 bus) Interrupt-handling systems Memory enhancement and virtual memory Microprogrammed systems

585. Digital Systems Design. (Com S 585) (3-0) Cr 3. *Prereq 584.* Perspectives on system design Reliability Redundant and fault-tolerant systems. Documentation standards. Test maintenance philosophy Arithmetic processor design, including floating-point and pipelined units. Simulation languages Packaging and power distribution. Clock and timing principles

588. Advanced Microcomputer Design. (3-0) Cr 3 *Prereq: Cpr E 487* A study of microcomputer system design, involving both software and hardware details and trade-offs An exhaustive survey of modern microprocessors

589. Advanced Digital System Architecture. (Com S 589) (3-0) Cr 3 *Prereq: Cpr E 385 or Com S 501* Innovations in the architecture and organization of computing systems Impact of technology on computer architecture Trade-offs in alternative implementations of system features

590. Special Topics. Cr 1 to 6 each time elected Formulation and solution of theoretical or practical problems in electrical or computer engineering When offered with a letter suffix, a topic is designated as follows
A Electromagnetic theory
B Control systems
C Communication systems
D Circuit theory
E Computer engineering
F Electric power
G Electrical materials
H Electronic devices and circuits

592 Seminar in Computer Engineering Cr 1 to 3 each time elected *Prereq Permission of instructor*

593. Seminar in Control Systems Cr 1 to 3 each time elected *Prereq Permission of instructor*

594. Seminar in Electric Power Cr 1 to 3 each time elected *Prereq Permission of instructor*

595. Seminar in Electromagnetics. Cr 1 to 3 each time elected F S *Prereq. Permission of instructor*
A Antennas
B Tropospheric and scatter propagation
C Coherent optics
D Plasmas
E Microwave power
F Remote sensing
G Microwave engineering
H Radio astronomy

Courses for Graduate Students, major or minor

610. Advanced Topics in Electromagnetics. Cr 1 to 3 each time elected F S *Prereq Permission of instructor*
A Antennas
B Electromagnetic theory
C Microwave engineering
D Radio astronomy
E Contemporary topics

620 Error Detection and Correction. (3-0) Cr 3 Alt yr as arr *Prereq 584* Mathematical foundation of error detection and correction Shift registers and pseudorandom sequences Group codes, cyclic codes Implementation of error detection and correction in digital systems

624. Digital Signal Processing. (3-0) Cr 3 Alt yr *Prereq 474* Discrete time signals and systems Application of the z-transform to discrete-time systems Discrete Fourier transform and its relation to discrete Fourier series and z-transform Linear convolution using the DFT Parameter quantization effects. Design techniques for IIR and FIR digital filters, including computer-aided mathods, FFT algorithms and general computational considerations Discrete Hilbert transforms and their applications. Discrete random signals. Effects of finite register length in the realization of IIR and FIR filters and DFT computations. Selected applications of digital signal processing techniques

653. Advanced Topics in Electric Power Engineering. (3-0) Cr 3 each time elected *Prereq Permission of instructor* Advanced topics of current interest in electric power system engineering
A. High voltage engineering
B System planning
C System dynamics
D Probabilistic methods
E Control and operation
F Power electronics
G Energy conversion
H DC transmission systems
I Lightning and switching surges

671 Optimal Estimation in Control Systems. (3-0) Cr 3 Alt Yr as arr *Prereq 521* Vector Gauss-Markov process Discrete-time Kalman filtering Modeling random processes in state form Smoothing algorithms Applications Continuous-time Kalman filtering Linearized and extended Kalman filter Separation theorem of optimal control

672. Optimal Control. (3-0) Cr 3 Alt yr as arr *Prereq 578* The optimal control problem Variational approach Pontryagin's principle, Hamilton-Jacobi equation Dynamic programming Time-optimal, minimum fuel, minimum energy control systems The regulator problem Structures and properties of optimal controls Optimization by direct methods

674. Advanced Topics in Systems Engineering. (3-0) Cr 3 each time elected *Prereq Permission of instructor* Advanced topics of current interest in circuit and control theory
A Circuit theory
B System stability
C Large-scale systems
D System identification
E Optimal control
F Nonlinear systems
G Stochastic systems
H Discrete-time systems

685. Advanced Topics in Digital Systems. (3-0) Cr 3 each time elected *Prereq 585* Advanced topics in computing systems taken from current literature

690. Advanced Topics Cr var

699 Research Cr var

Elementary Education

Jess R Beard, Head of Department

Professors: Beard, Breiter, Coulson

Emeritus Professor: Merkley

Associate Professors: Barnhart, Baum, Downs, Henney, Kelly

Assistant Professors: Abelson, Dixon, Duffelmeyer, Jones, Peterson, Shaw, Shirley

Instructors: Britson, Connor, Hoy, Killmer, Rayman, Sampson, Webb

Undergraduate Study

For the undergraduate curriculum in education, major in elementary education, leading to the degree Bachelor of Science, see *Education Curriculum*

The curriculum in elementary education is planned for persons who want to teach at the elementary school level The department also offers approval programs in reading and in mental disabilities Students who enroll in elementary education must make application to and be accepted by the teacher education committee in elementary education and the University Committee on Teacher Education, prior to classifying in advanced elementary education courses For admission and certification requirements, see *College of Education*

Graduate Study

Graduate programs with a specialization in elementary education or learning disabilities and graduate certification programs in learning disabilities and emotional disabilities are administered through the Department of Professional Studies in Education

Open to graduate students for minor credit only 450, 451, 457, 460

Courses Primarily for Undergraduate Students

100. Freshman Orientation. Cr R F S Overview of elementary education, curricular opportunities in the major, and program planning Required of all freshman majoring in elementary education

200. Sophomore Orientation Cr R F S Overview of elementary education, program planning, and application for admission to teacher eduation Required of all sophomores majoring in elementary education

204. Foundations of American Education. (Sec Ed 204) See *Secondary Education*

226. Development and Guidance in Middle Childhood (C D 226) See *Child Development*

240. Literature for Children. (C D 240) See *Child Development*

250. Education of the Exceptional Learner (3-0) Cr 3 F S SS An overview of exceptional learners Emphasis on identification, educational and vocational needs, and current practices

280. Teacher Aide (Sec Ed 280) See *Secondary Education.*

290 Independent Study Cr 1 to 3 *Prereq Permission of department head*

300 Transfer Orientation. Cr R F S Overview of elementary education, program planning, and personal development Required of all transfer students majoring in elementary education

301 Instructional Media. (Sec Ed 301) See *Secondary Education.*

342 Guidance of Children. Theories and Practices (C D 342) See *Child Development*

345 Strategies in Teaching (3-0) Cr 3 F S SS *Prereq 250, to be taken concurrently with 375, 445, or 446* Introduction to basic education teaching strategies

360 Education of the Mentally Disabled (3-0) Cr 3 *Prereq 250* A study of the physical, emotional, social and learning behaviors of the mentally disabled as related to education and vocational programs

365 Analyzing Learning Problems. (3-0) Cr 3 F S *Prereq 360* Formal and informal diagnostic instruments used by teachers to determine the academic and adaptive behavior levels of mentally disabled students

375 The Teaching of Reading. (4-0) Cr 4 F S SS Prereq Credit or classification in 250, 345 Approaches to developmental reading in elementary schools, emphasis on basal and content area materials and skills Field experience teaching reading to elementary school children

406. Multicultural Awareness and Non-Sexism in the Classroom. (Sec Ed 406) See *Secondary Education*

417A, 417B, 417C Supervised Student Teaching Cr 8 each F S *Prereq GPA 2.3, senior classification, 375, 445, 446, reservation required* Supervised teaching experience 417A Primary grades 417B Intermediate grades 417C Mentally disabled

430. Curriculum for Mildly Mentally Disabled (3-0) Cr 3 *Prereq 360* Methods and materials employed to teach borderline and mildly mentally disabled students

431. Curriculum for Moderately Mentally Disabled. (3-0) Cr 3 *Prereq 360* Methods, materials, and approaches commonly used in teaching functional living skills, self-help skills, social and adjustment, and vocational skills to moderately disabled students

432. Programming for Mentally Disabled Secondary Students. (3-0) Cr 3 *Prereq 360* Educational approaches to teaching independent living skills and vocational preparation for mentally disabled adolescents

433. Community Programs for Mentally Disabled Students. (3-0) Cr 3 *Prereq. 360* Study of community involvement and sheltered workshop opportunities for mentally disabled adolescents.

434. Seminar: **The Mentally Disabled.** (2 to 4-0) Cr 2-4 *Prereq: 360* A variety of topics concerned with education of mentally disabled students. Topic will vary each semester, e g , parent counseling, career education, vocational guidance Credit may be repeated

445. **The Teaching of Language Arts and Social Studies.** (4-0) Cr 4 F.S.SS *Prereq Credit or classification in 250, 345.* Methods, materials, and development of the individual's teaching skills Includes simulated, peer, and limited elementary classroom experiences

446 **The Teaching of Mathematics and Science.** (4-0) Cr 4 F S SS *Prereq: Credit or classification in 250, 345* Procedures for teaching mathematics and science to children Emphasis on developmental implications, teaching methods, discovery-inquiry approach, and innovative programs Field experiences in elementary classrooms and an environmental outdoor setting

447 **Teaching in the Kindergarten.** (3-0) Cr 3 F S SS *Prereq 250* Applicetion of developmental processes to learning, contemporary trends and issues in curriculum planning, and screening procedures.

450. **Ethnicity and Learning.** (3-0) Cr. 3. *Prereq 345.* Examination of the ethnically different learner in the classroom setting, with emphasis on cultural relevance in instruction

451 **Ethnicity and Learning Practicum.** (1-4) Cr 3. *Prereq 450* Field experience in a multi-ethnic classroom setting, with seminar discussion of these experiences.

457 **Teaching Exceptional Learners in the Regular Classroom.** (3-0) Cr 3 F S SS. *Prereq: 250.* Emphasis on teaching techniques, teacher attitudes, and instructional modifications for mainstreaming exceptional learners (learning disabilities, emotional disabilities, mental disabilities, physically and perceptually handicapped, and gifted and talented children)

458. **Field Experience and Practicum with Mentally Disabled Learners.** (0-4) Cr 1 *Prereq Classification in 360 and 365* Observation and involvement with mentally disabled children One semester hour required in a resource room setting and one in a self-contained MD room Must be taken twice

460 **Evaluating Classroom Learning.** (3-0) Cr 3 *Prereq 375* Emphasis on application of both formal and informal achievement test data to classroom teaching practices

468 **Supervised Practicum in Teaching.** (0-16) Cr 2 F S *Prereq 250, classification in 345, permission of instructor* Observation and involvement with children in a supervised elementary classroom while engaged in other elementary methods courses (375, 445, 446)

475. **Meeting Individual Needs in Reading Instruction.** (3-0) Cr 3 F.S. *Prereq 375* Innovations in approaches, materials, individualization, special learners, diagnosis, developing materials and instruction based on needs Field experience

490 **Independent Study.** Cr 1 to 5 *Prereq Permission of department head*
H Honors

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

520 **Teaching Strategies for Individualized Instruction.** (2-0) Cr 2 S SS. *Prereq 9 credits in behavioral sciences* Analysis of current trends and practices for individualizing instruction

521 **Gifted Children and the Elementary School.** (3-0) Cr 3 F *Prereq. 9 credits in education.* Survey of major areas of concern in the field of teaching gifted children

522. **Principles of Corrective Reading.** (2-0) Cr 2 F.SS. *Prereq 375.* Identification, analysis, and correction of reading problems within the elementary program

523. **Principles of Corrective Mathematics.** (2-0) Cr 2 S SS *Prereq 446* Identification, analysis, and correction of mathematics problems within the elementary program.

524. **Educational Interventions for Emotionally Disabled/Chronically Disruptive Children.** (3-0) Cr 3 *Prereq Teaching certificate.* Analysis of current trends and practices. Emphasis on therapeutic intervention systems, behavioral manifestations, and etiology

525. **Analyzing the Educational Problems of Emotionally Disabled/Chronically Disruptive Children.** (3-0) Cr 3. *Prereq Teaching certificate.* Individual educational diagnostic procedures and techniques

526. Seminar: **Research in Educational Procedures for Emotionally/Disabled/Chronically Disruptive Children.** (2-0) Cr 2 *Prereq: 524, 525.* Critical review of recent literature in education and psycho-behavioral sciences as applied to education of emotionally disabled/chronically disruptive children

531. **Teaching Gifted Children in the Elementary School.** (3-0) Cr 3 S *Prereq 9 credits in education* Emphasis on teaching strategies and program development

540. **The Child with Learning Disabilities.** (3-0) Cr 3 F SS *Prereq 9 credits in behavioral sciences* Conceptualizations of characteristics of the learning disabled as well as possible etiologies of learning problems

541. **Teaching Strategies for Learning Disabilities.** (3-0) Cr 3 *Prereq 455 or 540* Analysis of techniques and materials for remedying specific learning disabilities

590. **Advanced Topics.** Cr 1-5 *Prereq 15 credits in education, permission of department head*

591A, 591B, 591C, 591D. **Supervised Field Experience.** (0-3 to 9) Cr 1 to 6. F S SS *Prereq 15 graduate credits in special area* Supervised on-the-job field experience in special areas 591A. Learning disabilities 591B Emotional disabilities — mild 591C Emotional disabilities — moderate to severe 591D Gifted and talented

593. **Workshop.** Cr 1 to 5 SS *Prereq 15 credits in education*

Courses for Graduate Students, major or minor

615. **Seminar.** (1 to 3-0) Cr 1 to 3 F S

699. **Research.** Cr arr *Prereq 15 credits in education*

Energy Systems Engineering

(Interdepartmental Minor)

William J Cook, Chair of Supervisory Committee

Supervisory Committee: H A. Cowles, R. T. Greer, J. D Iversen, S J Marley, T D McGee, D I. McKeown, A H Pulsifer, A G Potter, A F Rohach, J C Young

Minor graduate work is offered in energy systems engineering under a cooperative arrangement with various departments including Aerospace Engineering, Agricultural Engineering, Architecture, Chemical Engineering, Civil Engineering, Electrical Engineering, Engineering Science and Mechanics, Industrial Engineering, Materials Science and Engineering, Mechanical Engineering, and Nuclear Engineering.

Staff and facilities exist in several departments to assist the engineer with interest in bulk power or energy systems to pursue either advanced academic training or research. The departments named above are involved with energy systems and all offer graduate study and research opportunities. These include: fossil and nuclear power plants; transmission systems; power system analysis and control; utility rate structure, depreciation and valuation; engineering economics, energy supply and transport; environmental impact of energy systems, materials utilization and processing; energy resources, conservation, conversion and utilization; and other energy related topics

The normal prerequisite to minor graduate work in energy systems engineering is the completion of undergraduate work substantially equivalent to that required for engineering students at this University. Because of the diversity in energy systems engineering it is possible for students to qualify for graduate study in some of the above areas even though their undergraduate or prior graduate training has been in a discipline other than engineering.

Students minoring in energy systems engineering will select a block of courses from an approval list to achieve a stated energy-related objective A member of the Energy Systems Engineering Supervisory Committee will serve on the student's program of study committee and will assist in defining a suitable minor program. The approved list of courses is available from the chairman of the supervisory committee.

Usually a block of 8 hours will be required as a minor for the master's degree and 12 hours as a minor for the doctoral degree. Energy Systems Engineering (E E, M E, Nuc E 543) shall be included in the student's program. The remainder of courses should be selected from those offered in two majors other than the student's major, at least one of which shall be outside the student's department.

Engineering Journalism

Administered by the Department of Industrial Engineering in cooperation with the Department of Journalism and Mass Communication.

Leading to the degree Bachelor of Science in engineering operations. Minimum credits required — 128.5.

A program in engineering journalism has been designed in the engineering operations curriculum for students who desire a knowledge of the fundamentals of management, engineering, science, communications, and human behavior, and who do not wish to pursue the more specialized engineering curricula. Graduates of this program should find interesting opportunities in a number of administrative areas in industry such as technical information, industrial communications, public relations, engineering sales, procurement, and production

Additional information concerning the journalism courses and requirements may be obtained from the chairman of the Department of Journalism and Mass Communication. Required courses in the engineering journalism program include all the required courses in the engineering operations curriculum except as noted below.

The following number of credits in journalism must be included for the engineering journalism program.

Cr.	I. Basic Core Courses
2	Introduction to Mass Communication — JI MC 101
8	Basic Reporting, Writing, Editing — JI MC 201, 202, 203
3	Law of Communication — JI MC 430
1	Professional Seminar — JI MC 4991
2	Professional Media Internship — JI MC 499
16	

II. Skills Courses

Students must select a minimum of 9 credits of 300-level courses according to their area of specialization. One of the courses selected must come from the following group: Jl MC 345, 352, 354, 360, 361, 370 The remainder may be taken from the above courses or from any other 300-level journalism courses.

III. Advanced Courses

Students must select a minimum of 5 credits of 400-level courses in addition to those required in the basic core. The one of these 400-level courses must come from the following group· Jl MC 410, 431, 462 The remainder may be taken from the above courses or from any other 400-level courses except 490, 491 or 499 Students, in consultation with their advisers, should select courses which complement their areas of specialization

A 400-level journalism course, preferably 430, may be substituted for Mgmt 315, and a 300-level course, preferably 360, for Engl 414 Two courses selected from 425, 431, 440, 462, and 464 may be taken as sociohumanistic electives, and four other 300- and 400-level courses as management-business electives

*National journalism accreditation standards recommend that the number of journalism credits on the degree program be limited to approximately one quarter of total credits taken

Engineering Operations

Administered by the Department of Industrial Engineering

Roger W Berger, Chair, Advisory Committee

Advisory Committee: D E Grant, K L McRoberts, G. M Montag, R C Vaughn

Programs are offered in the engineering operations curriculum, leading to the degree bachelor of science A five-year cooperative program is available For more information see *Cooperative Education Programs, College of Engineering*

Course for Undergraduates.

291. Seminar. (1-0) Cr R F Orientation to the engineering operations program and career opportunities Registration is required by the end of the sophomore yeer, or for transfer students, during the first semester after entry into engineering operations

Engineering Science

Administered by the Department of Engineering Science and Mechanics.

Harry J Weiss, Head of Department

Undergraduate Study

For the undergraduate curriculum in engineenng science leading to the degree bachelor of science, see *College of Engineenng, Curricula*

The curriculum in engineering science is designed particularly for those students who wish to receive comprehensive training in the fundamental principles and concepts of engineering rather than specialize in one particular field The core of the program, which is based on a background in chemistry, mathematics, and physics, consists of mechanics of solids, mechanics of fluids, nature and properties of materials, electrical theory, thermodynamics, and rate processes A sequence in analysis and design in the sophomore, junior and senior years serves to integrate the entire program in engineering science

The curriculum is well adapted as a base for those students who wish to enter the research, development, or design areas of engineering or who intend to pursue a graduate program in one of the departments in the College of Engineering By a judicious choice of electives in the senior year, it is possible to go on and attain a master of science or master of engineering degree in either two or three additional semesters beyond the bachelor's degree Program plans for such integrated bachelor-master degrees are available in a number of professional areas in the College of Engineering for appropriately qualified students — e g , engineering mechanics, nuclear engineering, biomedical engineering, and civil engineering, as well as in many non-engineering areas

Graduate Study

Minor work is available to students taking major work in other departments

Open to graduate students for minor graduate credit only 351, 352, 380, 412, 481, 482, 490

Courses Primarily for Undergraduate Students

100 Technical Lecture (1-0) Cr R S

280. Basic Engineering Design I (2-2) Cr 3 S *Prereq A FORTRAN computer programming course, credit or classification in E M 274* Numerical methods in design Characterization and idealization of systems, application of basic principles of mechanics to idealized models emphasizing digital and analog computational techniques

298, 398, 498. Cooperative Education. Required of all cooperative students *Prereq Permission of department head* 298 Work periods for students with sophomore standing in a regularly established program 398 Work periods for juniors. 498. Work periods for seniors Students must register for these courses prior to commencing each work period

351 Engineering Materials. (M S E 351) (3-2) Cr 4 F *Prereq Credit or classification in E M 324* Resistance of materials to failure, definitions and evaluation of properties, relationship to design Effects of environment on properties Laboratory determinations Structure of materials, and influence of structure upon properties

352. Engineering Materials. (M S E 352) (3-2) Cr 4 S *Prereq* 351 Thermal, magnetic, and electncal characteristics, properties of single crystals, poly-crystalline systems, eggregates of domains Interatomic forces, energy considerations. Engineering applications

380. Basic Engineering Design II. (2-2) Cr 3. S *Prereq 280* Design of experiments to measure basic parameters, interpretation of experimental data and empincal relationships.

401, 402. Seminar. (1-0) Cr R Yr *Prereq Senior classification*

412. Energy Sources and Utilization. (3-0) Cr 3 S *Prereq. M E 331, E M 378 or M E 335* Sources of energy, methods of utilization and transformation Over-all design of energy systems

481, 482. Advanced Analysis and Design. (3-0) Cr 3 each Yr *Prereq. 481, 380, a fluids course, 482 481* Application of the engineering sciences to the analysis and design of components and systems

490. Independent Study. Cr 2 to 5 *Prereq Permission of department head* Investigation of an approved problem commensurate with the training, interest, and ability of the student
H Honors

Engineering Science and Mechanics

Harry J. Weiss, Head of Department

Professors: Burger, Graham, Greer, McConnell, Nariboli, Riley, Rogge, Schmerr, D Thompson, R Thompson, Tsai, Weiss, Young

Professors Emeritus: Ohlsen

Associate Professors: Akers, Holger, Huston, Johnson, Munson, Petersen, Zachary

Assistant Professors: Rudolphi, Sturges

Undergraduate Study

The courses in mechanics are intermediate between those in physics and mathematics and the professional and design courses of the several engineering curricula In the work of this department the student is expected to acquire an understanding of the principles underlying the technique of analysis and a knowledge of those properties of materials which influence the manner and extent of their use for engineering purposes Students are expected to gain some insight into the background of purchase and design specifications Physical properties of engineering materials are studied in the classroom and are evaluated in the laboratory General laws, such as those of Newton, are given mathematical expression and are made suitable for use in the solution of specific problems in machine and structural design, and in the flow and measurement of fluids

Graduate Study

The department offers work for the degrees Master of Science, Master of Engineering, and Doctor of Philosophy with major in engineering mechanics, and minor work to students taking major work in other departments

The Master of Science degree requires a thesis and a minimum of 8 research credits It has strong research emphasis and is recommended for students who anticipate entering a doctoral program later At least 30 hours of acceptable graduate work are required for the degree

The Master of Engineenng degree does not require either research credits or a thesis However, at lease 2 credits of acceptable creative endeavor-and at least 26 credits of acceptable graduate course work are required A minimum of 30 credits of acceptable graduate work is required for the degree The program is intended to give students additional instruction at the graduate level to better qualify them for advanced professional engineering work. By careful selection of electives and perhaps additional courses during the senior undergraduate year, students should be able to qualify for the master of engineering degree with an additional year of full-time study after receiving their baccalaureate degree in one of the several engineering curricula.

Credits for creative endeavor will be obtained by registering for E M 690M. The achievement will be determined by means of a written report and an oral presentation to the student's graduate committee

The normal prerequisite to major graduate work is the completion of a curriculum substantially equivalent to that required of undergraduate students in engineering at this University. However, because of the diversity of interests in graduate work in engineering mechanics, it is possible for a student to qualify for graduate study even though undergraduate or prior graduate training has been in a discipline other than engineering — e.g , physics or mathematics

Cooperative programs between Engineering Mechanics and Biomedical Engineering are provided jointly under the sponsorship of the Colleges of Engineering and Veterinary Medicine. Laboratory facilities are available in both the Biomedical Engineering Building and the Laboratory of Mechanics. See *Biomedical Engineering* for requirements. The department participates in the interdepartmental minor program in Energy Systems Engineering. (See Index)

Courses open to graduate students for minor graduate credit only: 301, 324, 327, 337, 345, 370, 370L, 378, 417, 425, 444, 451, 484

Courses Primarily for Undergraduate Students

274 **Statics of Engineering.** (3-0) Cr 3 F S SS *Prereq Credit or classification in Math 166, credit or classification in Phys 111 or 221.* Vector and scalar treatment of coplanar and noncoplanar force systems Resultants, equilibrium, friction, centroids, moments and products of inertia of areas, Mohr's circle, radius of gyration, internal forces, shear and bending moment diagrams

301 **Fundamentals of Mechanics.** (4-0) Cr 4 F S SS *Prereq Phys 221, Math 166.* Newton's laws, equilibrium of rigid and deformable bodies, stress Kinematics and dynamics of particles and rigid bodies Deformation and strain of solids and fluids, constitutive equations for solids and Newtonian fluids Applications to tension, torsion, flexure of solid bars and vibrations E M 301 can not be used for credit toward graduation for students who have completed E M 324 or E M 345 or their equivalent

324 **Mechanics of Materials.** (3-0) Cr 3 F.S.SS *Prereq 274* Plane stress, plane strain, stress-strain relationships, and elements of material behavior Application of stress and deformation analysis to members subject to centric, torsional, flexural, and combined loadings. Elementary considerations of theories of failure, buckling, repeated and impact loads.

*327 **Mechanics of Materials Laboratory.** (0-3) Cr 1 F S SS *Prereq. 301 or credit or classification in 324* Experimental determination of mechanical properties of selected engineering materials. Experimental verification of assumptions made in 301 and 324 Use of strain measuring devices. Preparation of reports

*337. **Engineering Materials.** (M S E 337) (2-3) Cr 3 F S SS *Prereq: 301 or credit or classification in 324.* Properties, uses, and manufacture of metals, timber, stone, clay products, cements, concrete, and other engineering materials. Laboratory work similar to 327 with additional topics and added emphasis on concrete

345. **Dynamics.** (3-0) Cr 3. F.S SS. *Prereq. 274, Credit or classification in Math 266 or 267.* Particle and rigid body kinematics, Newton's laws of motion, rigid body kinetics. Work-energy, linear and angular impulse-momentum, rotating coordinates, Coriolis acceleration Applications to gyroscopic motions, impact and vibrations.

370. **Principles of Nondestructive Testing.** (M S E 370) See *Materials Science and Engineering.*

370L. **Nondestructive Testing Laboratory.** (M S E 370L) See *Materials Science and Engineering*

378. **Mechanics of Fluids.** (2-2) Cr 3 F S.SS. *Prereq: 274 or 301* Properties of fluids Fluid statics. Kinematics and kinetics of fluid flow Impulse-momentum, dimensional analysis, flow in pipes and channels, engineering applications Selected laboratory experiments

417. **Experimental Mechanics.** (2-2) Cr 3. F *Prereq. 301 or 324* Introduction to experimental methods in mechanics with application to practical engineering problems. Strain measurement methods, transducer applications, recording and output devices, motion measurement methods Selected laboratory experiments

425. **Introduction to the Finite Element Method.** (3-0) Cr 3 S *Prereq 301 or 324, Math 266 or Math 267.* Introduction to finite element analysis with applications to problems such as stress-deformation analysis, fluid and heat flow, potential flow, torsion, wave propagation Use of simple codes for computer solution of problems

444. **Mechanical Vibrations.** (2-2) Cr 3 F.S *Prereq 324, 345, knowledge of FORTRAN* Elementary vibration analysis, single and multiple degrees of freedom, energy methods, free and forced vibrations, viscous damping, transmissibility, influence coefficients, matrix methods, lateral vibrations of beams Selected laboratory experiments.

451. **Engineering Acoustics.** (M E 451) (2-2) Cr 3 F S *Prereq. Phys 221 and Math 266 or 267* Sound sources and propagation Noise standards and effects of noise on man. Principles of noise and vibration control used in architectural and engineering design Characteristics of basic noise measurement equipment Experience in use of noise measuring equipment, sound power measurements, techniques for performing noise surveys, evaluation of various noise abatement techniques applied to common noise sources Laboratory and field experiments

484. **Principles of Similitude and Modeling.** (2-2) Cr 3 F S *Prereq. 301 or 324, a fluids course* Dimensional analysis and modeling Principles governing the design and operation of models for solution of engineering problems Analogies

490. **Independent Study** Cr arr *Prereq Permission of instructor*

H Honors

*Students who are not present for the first laboratory meeting of their own sections may qualify for continuation in the course only by attending the first laboratory meeting of some other section of either of these two courses.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

504, 505. **Analytical Methods in Mechanics.** (3-0) Cr 3 each Yr *Prereq. 504. Math 385, 505. 504* Applications of the equations of heat conduction, potential theory, and wave propagation to problems in mechanics Methods of solution

514. **Advanced Mechanics of Materials.** (3-0) Cr 3 F *Prereq. 324.* Theory of stress and strain, stress-strain relationships. Limitations of flexure and torsion formulas, unsymmetrical bending, curved beams, cross-shear, shear center Torsion of thin-walled noncircular sections Theories of failure, membrane stresses in shells, thick-walled cylinders

515. **Stability.** (3-0) Cr 3 S *Prereq 324* Stability of colums, beam-columns, bars and frames. Inelastic buckling, torsional buckling, bending and buckling of thin plates and shells.

516. **Applied Elasticity.** (3-0) Cr 3. S. *Prereq. 514* Basic equations of plane elasticity theory, Airy stress function and Prandtl torsion function with applications. Virtual work, least work, and other energy methods.

517. **Experimental Stress Analysis.** (3-2) Cr 4 S *Prereq. 324.* Fundamental concepts of strain measurement, properties of stress coat and its application, wire, foil, and semiconductor strain gages, strain gage circuits and recording instruments, rosette analysis Two- and three-dimensional photoelasticity, compensation techniques, principal stress separation using shear difference, oblique incidence and other methods, birefringent coatings, scattered light, design of models, moire methods, introduction to holography.

519. **Experimental Methods of Motion Measurement.** (2-2) Cr 3. Alt. S., offered 1983. *Prereq: 417, 444.* Description, specifications, limitations, and applications of mechanical, electrical, and optical transducers used in motion measurements applied to steady state, transient, and shock motions. Calibration, signal conditioning, and transducer systems used to obtain reliable and reproducible experimental data. Seismic and absolute references for motion measurement.

520. **Biomechanics.** (B M E 520) Cr. 3. S. *Prereq: Phys 111 or 221, Math 265.* For students with interests in the life sciences who wish to obtain background in applied mechanics. Equilibrium, vibratory motion, stress and deformation, material properties, flow of fluids, dimensional analysis and modeling of biological systems. Examples taken from biology and medicine

525. **Finite Element Analysis.** (3-0) Cr. 3. F. *Prereq: 324* Application of the finite element method to problems of engineering Plane strain and plane stress problems of solid mechanics. Potential problems related to fluid mechanics and heat transfer Viscous flow problems. Element shape functions for plates and shells Introduction to the boundary solution procedure

537. **Experimental Fluid Mechanics.** (M E 537) See *Mechanical Engineering.*

544. **Mechanical Vibrations.** (2-2) Cr 3 F. *Prereq: 324, 345* Elements of lumped parameter linear systems, kinematics of vibrations, equations of motion for free and forced vibrations, energy methods, resonance, damping, multiple degrees of freedom, mechanical impedance, isolation and absorption of vibrations with impulsive and arbitrary excitation of linear systems, primary and residual shock spectra.

546. **Introduction to Random Vibrations.** (3-0) Cr 3 Alt S , offered 1982 *Prereq: 544.* Characteristics of random vibrations, random processes, probability distributions, spectral density and its significance, the normal or Gaussian random process Transmission of random vibration, response of simple single and two-degree-of-freedom systems to stationary random excitation Fatigue failure due to random excitation

548. **Advanced Engineering Dynamics.** (3-0) Cr. 3. F *Prereq 345, Math 266 or 267.* Dynamics of particles and rigid bodies Orbital motion. Generalized coordinates Lagrangian equations of motion Equations of motion in terms of Eulerian angles, motion of a gyroscope Applications to engineering problems

549. **Vehicle Dynamics.** (3-0) Cr. 3. Alt. S. offered 1982. *Prereq 345, Math 266 or 267.* Theory and engineering principles of road and off-road ground vehicles. Analysis and evaluation of performance characteristics, handling behavior, and ride qualities.

551. **Noise Source Analysis.** (M E 551) (2-2) Cr 3 S *Prereq 444 or 451, a fluids course, Math 385.* Analysis of basic noise sources including typical noise source mechanisms for rotating machinery, fluid-structure interactions, internal and external flows. Techniques used in noise source identification including analog and digital frequency analysis.

555. **Biomedical Fluid Mechanics.** (B M E 555) (3-0) Cr. 3 S. *Prereq. 520.* Applications of principles and concepts of fluid mechanics to problems in biology and medicine Hemodynamic characteristics of the circulation, rheology of blood flow in the microcirculation, flow in the large arteries, and the respiratory system.

560. **Scanning Electron Microscopy Characterization of Materials.** (M S E 560) (2-2) Cr. 3. F. *Prereq: E Sci 351.* Property-material comparisons of metals and biomaterials emphasizing microstructural-microchemical findings as demonstrated by scanning electron microscopy and scanning transmission electron microscopy Characterization by scanning electron microscope and energy-dispersive X-ray microchemical analysis.

564. **Fracture and Fatigue.** (M S E 564, M E 564) (3-0) Cr 3. F. *Prereq: 324 and any of 337, E Sci 352, M S E 231, 270 or 271.* Materials and mechanics approach to fracture and fatigue Fracture mechanics, brittle and ductile fracture, fracture and fatigue characteristics. Fracture and fatigue tests, thermal fracture, mechanics and materials designed to avoid fracture or fatigue.

568. **Plasticity and Creep of Materials.** (M S E 568) (3-0) Cr 3 Alt F offered 1981. *Prereq: 324.* Mechanics and materials approach to plasticity and creep in materials and ceramics. Yield criteria, flow rules, slip-line theory, dislocation dynamics, work hardening and metal forming processes. Introduction to creep mechanisms, stress-rupture, engineering application of creep data.

569. **Mechanics of Composite and Combined Materials.** (M S E 569) (3-0) Cr. 3. Alt. S. offered 1983. *Prereq: 514.* Mechanics of fibrous and laminated composites and of combined materials such as multilayered thick-walled cylinders. Macromechanical and micromechanical behavior of lamina and laminates

Strength, stiffness and interlaminar stresses of laminates. Fracture mechanics applied to composite materials.

571, 572. Advanced Fluid Mechanics. (M E 571, 572) 571. (3-0) Cr. 3. F., 572: (3-0) Cr 3. S. *Prereq. 571: 378 or M E 335; 572: 571.* Fundamental relationships of fluid dynamics, real and ideal fluids, laminar and turbulent flow; flow in closed conduits and open channels; boundary layer theory; two- and three-dimensional potential flow problems, engineering applications. 572. Application of complex variables to two-dimensional fluid flow; flow around solid bodies, free streamline theory Exact and approximate solutions to Navier-Stokes equations for one- and two-dimensional laminar flow problems, both steady and unsteady flows; exact and approximate solutions to one- and two-dimensional boundary layers, introduction to turbulent boundary layers Application to engineering problems

580. Biomaterials. (B M E 580; M S E 580) (3-0) Cr 3 S *Prereq. permission of instructor.* Basic chemical and physical properties of biomaterials related to manipulation by the engineer for incorporation into living systems Role of microstructure properties in the choice of biomaterials and design of artificial organs, implants, and prostheses.

590. Special Topics. Cr 1 to 4 each time taken
A Advanced Engineering Acoustics
B Linear Wave Propagation
C Thermal Stresses in Design
D Linear Viscoelasticity
E Biomechanics
F Other Topics

Courses for Graduate Students, major or minor

620. Seminar.(1-0) Cr 1

630. Continuum Mechanics. (3-0) Cr 3 Alt F offered 1982 *Prereq Math 385.* Cartesian tensors, kinematics, equations of balance, discontinuity surfaces, constitutive equations classical elasticity, Navier-Stokes equations and simple rheological models for viscoelastic solids and fluids

645. Advanced Vibration Analysis. (3-0) Cr 3 Alt F offered 1982 *Prereq 544, Math 385* Nonlinear vibration phenomena Multiple degrees of freedom, inertia and stiffness matrices, transfer matrices, numerical methods Vibration of continuous systems, limitations, and comparison of lumped approximations of continous systems Engineering applications

648. Advanced Topics in Dynamics. (3-0) Cr 3 Alt S offered 1983 *Prereq 548, Math 385* Topics of current interest in dynamics such as vehicle stability, modeling multicomponent dynamical systems and nonrigid body dynamics

650. Fluid Mechanics Seminar. (M E 650, Aer E 650) (1-0) Cr 1 each time taken *Prereq Permission of instructor* Special topics of current research interest to students and staff of departments concerned

651. Advanced Topics in Fluid Mechanics. (M E 651) (3-0) Cr 3 S *Prereq. 572* Topics of current interest in fluid mechanics such as separation phenomena, three-dimensional boundary layers, unsteady flow phenomena, asymptotic methods in viscous flows, stability, theory of homogeneous isotropic turbulence, and turbulence models

684, 685. Similitude in Engineering. (2-2) Cr 3 each. Yr *Prereq. 324, permission of instructor* Principles of dimensional analysis and their application to design of models. Design, testing, and interpretation of models True and distorted models, linear and nonlinear models, analogies. Applications

690. Special Topics. Credit 1 to 6 each time taken
A Advanced Experimental Mechanics
B Nonlinear Wave Propagation
C Nonlinear Material Behavior
D Composite Materials
E Holography in Mechanics
F Finite Elements of Nonlinear Continua
G Fracture Mechanics
H Atmospheric Fluid Mechanics
I Viscous Flow Theory
J Advanced Similitude Analysis
K Advanced Analytic Methods in Mechanics
L Rheology
M Creative Component
N Other Topics

699. Research.

English

Frank E Haggard, Chair of Department

Professors: R. Bataille, Benson, Bruner, P G Davies, Leonard Feinberg, A. E. Galyon, Haggard, Herrnstadt, Johnson, Jumper, Kratochvil, Lowrie, Palmer, Yates, Zbaracki

Emeritus Professors: Huntress, Mallam, McCay

Associate Professors: Consigny, Cummings, R R. Davies, Lilian O. Feinberg, Fowler, L R Galyon, Gwiasda, Irwin, LaSalle, McCarthy, Nakadate, Nostwich, Ross, Silet, Speer, Zimmerman

Assistant Professors: Anderson, G M. Bataille, Bowers, Catron, Devine, Ewald, Galenbeck, Geha, Gonzo, Hadley, Hickok, Hoover, Kienzler, Kroll, Martone, Matthies, McCully, Paul, Payne, Poague, Potter, Rosner, Rothmel, Roundy, Vann, Whitaker, Wright

Instructors: Beatty, Boston, Buckels, David, D. W Dunlop, M. H. Dunlop, Fry, Miller, Moore, Pearson, Sears, Sohn, Tedlock, Thralls, Underwood, Wiggers

Undergraduate Study

The department offers a wide variety of courses for students seeking a degree in English, as well as for students wishing to broaden their general education Course offerings include American, English, and world literature; basic and upper-level practical and creative writing, linguistics, film, reading, English education, and English for speakers of other languages

Many students select English courses to fill electives, to pursue a minor, to complement their professional training in other departments, and to investigate possible further study in English The discipline of English helps to develop students' understanding of how language functions in imaginative literature, mass media, and both personal and professional writing

Basic courses in the department are designed to improve the skills in comprehension and communication necessary for successful university work (See *Colleges and Curricula, Bachelor's Degree Requirements,* and *English Proficiency Policy* for information about English and communications requirements for each Iowa State University college program) The English Department has a Writing Center and a Reading Center (including English 200) to assist students seeking intensive instruction in these skills. The curricula in many departments call for course work beyond the freshman English program

The department offers a variety of special courses in English for speakers of other languages (both undergraduate and graduate students) and participates in the Intensive English and Orientation Program for foreign students (See *English Courses for Native Speakers of other Languages* and *English Requirement for International Students*)

Students graduating with a major in English or with a large number of courses in English usually find that their career opportunities are improved in those fields that demand special communication skills, e.g., advertising, sales, public relations, technical writing, publishing, business, public service, education, and financial services An undergraduate major in English is an excellent basis for professional study in law, medicine, and theology Students interested in teaching can qualify to teach English in the secondary schools. (See *College of Education* for teacher certification requirements.) Students who have completed an undergraduate major in English may also pursue graduate studies.

The English major, aided by an adviser, works out a program of study consistent with his or her own educational and professional objectives Majors are required to have at least 30 credits in English with a grade of C or above (in addition to 104-105 or 105H), those seeking secondary certification are required to have an additional 9 credits in English, apart from courses in teaching methods Credits are distributed as follows: basic courses in each of the department's three main areas — composition, language, and literature, an additional two courses from the British literature series 373-378 and two courses from the American literature series 360-363; and an additional two courses (or one course for majors seeking certification) selected from 366, 370, 391, 392, 449, 473, 474, 489 Furthermore, two of the courses are to be in British or American literature before 1800 Majors who do not declare a minor or a second major are urged to take at least 12 credits in a supporting field such as foreign language, linguistics, journalism, history, philosophy, psychology, speech, music, sociology, anthropology, women's studies, American Indian studies, and business administration. English majors may earn a Bachelor of Arts or Bachelor of Science degree The B S degree requires additional work beyond the minimum college requirements in linguistics, science, mathematics, or social science. Details of these requirements are available from departmental advisers

The English Department each year offers several scholarships and awards of modest sums Most of these are open to all undergraduates and are as follows. the English Activities and Recognition Club Scholarships, the James and Rachel Lowrie Award, the Critical Writing Award, the Pearl Hogrefe Awards, the Laura Vernon Scholarship, the Jumper Award, and the Professor W Paul Jones Scholarship

Graduate Study

The department offers work for the Master of Arts degree with a major in English, and minor work for students majoring in other departments The master's degree requires 30 semester credits, including a thesis (3 credits) or a major project (ordinarily 3 credits). Courses must include 530, 511 or 512, and usually 503 Basic knowledge of one foreign language must be demonstrated by test or course work Toward the end of the program, each candidate writes an examination covering a major author and a period or area in literature, linguistics, or other programs offered by the department agreed on by the candidate and the examination committee Candidates admitted to major graduate work should have completed undergraduate study substantially equivalent to that in the undergraduate program in English at Iowa State

Individual graduate programs of study are designed to prepare students for (1) teaching at the secondary, two-year college, or beginning college and university levels, (2) further graduate study in language and literature, (3) teaching English as a second language, (4) creative writing, (5) technical writing, editing, and associated commercial writing activities

The department participates in the interdepartmental program in Technology and Social Change (see Index) and provides practicum or similar experiences for English graduate students in the Writing Center, Reading Center, Intensive English and Orientation Program, Freshman English Program, and selected departmental research activities. Some financial assistance awards for graduate students are available.

Open to graduate students for minor graduate credit only: 315, 316, 335, 345, 346, 347, 349, 357, 366, 394, 400, 414, 420, 495. Graduate students in English may include 495 in their major programs of study. Selected courses in English may be used to meet part of the requirements for certification to teach English in two-year and community colleges (see department information bulletin).

Courses Primarily for Undergraduate Students

10. **Intensive English and Orientation Program.** (20-5) Cr 0. *Prereq: Recommendation of the English Department.* Full-time study of English for speakers of other languages. Brochure available from the Office of International Educational Service.

*100. **English for Native Speakers of Other Languages.** *Prereq: Recommendation of English Department, 100C. 100B or placement in 100C, 100D. 100B or placement in 100D.* Placement in various sections is determined by examination. (See *English Requirement for International Students* in Index.) For undergraduates: Completion of English 100 requirement prepares for English 104. For graduates: Completion of English 100 requirement satisfies the English requirement of the Graduate College.

A. Spoken English. Cr 2.
B. Intermediate-level Grammar Review and Composition. Cr 3.
C. Advanced-level Composition — Undergraduates. Cr 3.
D. Advanced-level Composition — Graduates. Cr 3.
E. Supervised Independent Study. Cr 1-2 each time taken.
   Section 1. Listening. Cr 1.
   Section 2. Vocabulary. Cr 1.
   Section 3. Reading. Cr 1.

*The University does not allow credit in English 100 to count toward graduation. Persons whose native language is English cannot take English 100 for credit.

104, 105, 105H. **Freshman Composition.** (3-0) Cr 3 each 104, 105: F S.SS, 105H: F. *Prereq: 105. 104 or exemption from 104, 105H. Exemption from 104 and admission to Freshman Honors Program.* Emphasis on development of writing skills. Eight to ten formal papers required each semester. Readings from a variety of sources.

199. **Introduction to the Study of English.** (1-0) Cr R F. *Prereq: 105.* General introduction to the discipline, discussion of the various fields in English, consideration of career opportunities. For English majors.

200. **Developmental Reading.** (0-2) Cr 1 each time taken, maximum of 2. F.S.SS. 8 weeks. Acceptable only for elective credit in sciences and humanities. Training in reading efficiently through comprehension, rate, and vocabulary exercises. Offered on a satisfactory-fail basis only. May be repeated only by permission of instructor.

201. **Introduction to Literature.** (3-0) Cr 3. F S SS. *Prereq: Credit or classification in 105.* Emphasis on comprehension of literature in its relation to recurrent human problems. Study of selected texts chosen to illustrate differing literary forms.

204. **Intermediate Composition.** (3-0) Cr 3. F S SS. *Prereq: 105, sophomore classification.* Developing skills necessary to organize extended pieces of writing. Emphasis on expository writing, use of research sources, and documentation. Revision and audience strategies stressed.

205. **Propaganda Survey and Analysis.** (3-0) Cr 3. F S.SS. *Prereq: 105.* Analysis of how newspapers, books, magazines, radio, television, and film convey facts, beliefs, judgments, and values. Special emphasis on verbal and nonverbal devices employed in the propaganda process. Students may be required to purchase selected periodicals, attend evening film screenings, and view certain television programs. Fee.

210. **Introduction to Literary Study.** (3-0) Cr 3. *Prereq: Credit or classification in 105.* Basic principles of literary study. Emphasis on writing of interpretive and critical essays. Particular attention to poetry. Designed for, but not limited to, English majors.

219. **Introduction to English Linguistics.** (3-0) Cr 3. F S.SS. *Prereq: 105.* Introduction to the principles of linguistic analysis with English as the primary source of data. Sound and writing systems, sentence structure, vocabulary, and meaning. Issues in the study of usage, regional and social dialects, and language change.

220. **Applied English Grammar.** (3-0) Cr 3. F. *Prereq: 219 or an introductory course in linguistics.* Principles of English grammar. Study of usage, dialects, error analysis. Teaching of grammar.

230, 231. **Literature and Culture.** (3-0) Cr 3 each. F S. *Prereq: Credit or classification in 105.* Selected literary texts chosen for their attention to important trends, values, attitudes, ideals, and beliefs of our own and past times. 230: British literature. 231: American literature.

300. **Selected Topics in Popular Culture.** (3-0) Cr 3 each time taken, maximum of 6. *Prereq: 105.* Selected topics in the study of the popular arts and extra-literary forms of expression. Examination of conventions, craftsmanship, social and historical significance of popular artists and their work.

302. **Business Communication.** (3-0) Cr 3. F S SS. *Prereq: 105, junior classification.* Principles governing current business communication. Problem approach to a range of assignments including persuasive and informative writing, job application letters and resumes.

303. **Free Lance Writing for Popular Magazines.** (3-0) Cr 3. *Prereq: 105.* Practical workshop in writing non-fiction articles for popular magazines. Emphasis on writing, market research, preparation of manuscripts, methods of submission. Major goal of the course is production of marketable material.

304. **Creative Writing — Fiction.** (3-0) Cr 3. *Prereq: 105, not open to freshmen.* Progresses from practice in basic techniques of fiction writing to fully developed short stories. Emphasis on writing, analytical reading, workshop criticism, and individual conferences.

305. **Creative Writing — Nonfiction.** (3-0) Cr 3. *Prereq: 105, not open to freshmen.* Progresses from basic exposition to fully developed critical and personal essays. Emphasis on writing, analytical reading, workshop criticism, and individual conferences.

306. **Creative Writing — Poetry.** (3-0) Cr 3. *Prereq: 105, not open to freshmen.* Progresses from traditional to modern forms. Emphasis on writing, analytical reading, workshop criticism, and individual conferences.

315. **Creative Writing — Screenplays.** (3-0) Cr 3 each time taken, maximum of 6. *Prereq: 105, not open to freshmen.* Stresses master scene technique of writing fully developed screenplays. Course may be repeated in conjunction with actual production of film or teleplay. Emphasis on TV and movie techniques, writing, workshop criticism, analytical reading and viewing, and individual conferences.

316. **Creative Writing — Playwriting.** (Sp 316) (3-0) Cr 3. *Prereq: 105, not open to freshmen.* Progresses from production of scenes to fully developed one-act plays. Emphasis on action, staging, writing, analytical reading, workshop criticism, and individual conferences.

335. **Film.** (3-0) Cr 3. F S. *Prereq: 105.* Principles of film art and the traditional vocabulary of literature as applied to film. Influence of film on modes of thought and behavior. Fee.

344. **Readings in Biography.** (3-0) Cr 3. Alt. Yr. *Prereq: 105, junior classificetion.* Selections from biography and autobiography of distinguished figures in a variety of fields. Study of different approaches to problems of biography and autobiography. Impact of creative individuals upon their own and later times.

345. **Literature by or About Women.** (W S 345) (3-0) Cr 3 each time taken, maximum of 6. *Prereq: 105.* Literature by women and/or dealing with the images of women.

346. **American Indian Literature.** (Am In 346) (3-0) Cr 3. Alt. Yr. *Prereq: 105.* Survey of literature of the American Indian from pre-Columbian tales and songs to contemporary novels and poetry.

347. **Survey of Black American Literature.** (3-0) Cr 3. S. *Prereq: 105.* Literature by Black Americans from the beginnings to the 1960's.

349. **Selected Topics in Minority Literatures.** (3-0) Cr 3 each time taken, maximum of 6. F. *Prereq: 105.* Literature by and/or about American ethnic minorities. May include literature of several ethnic groups or focus upon one of the following: Asian Americans, Black Americans, Hispanic Americans, American Indians.

353, 354. **World Literature.** (3-0) Cr. 3 each. Yr. *Prereq. 105.* 353: Ancient classics (Greek and Roman) to the Renaissance. 354: European masterpieces from the Neoclassical Age to the twentieth century.

356. **The Bible as Literature.** (3-0) Cr 3. *Prereq: 105.* Selected literature from Old Testament, New Testament, and Apocrypha including narrative, poetry, wisdom literature, and apocalyptic literature.

357. **Folk Literature and Myth.** (3-0) Cr 3. Alt. Yr. *Prereq. 105.* Folk literature, its types and functions, in both sacred and secular traditions. Emphasis on traditional narratives (epic, legend, ballad, folk and fairy tale), myth, proverbs, and riddles.

360. **American Literature from Its Beginning through Irving.** (3-0) Cr 3. F S. *Prereq: 105.* American literature from its Puritan beginnings through the colonial period to early romanticism, literary works and their social and cultural contexts.

361. **The Romantic Era in American Literature (1820-1865).** (3-0) Cr 3. F S. Alt. SS. *Prereq: 105.* American literature through the romantic era as it achieved international significance in the 1850's, literary works and their social and cultural contexts, Hawthorne, Emerson, Thoreau, Melville, Whitman.

362. **American Literature in the Age of Realism (1865-1914).** (3-0) Cr 3. F.S. Alt. SS. *Prereq: 105.* Realism and naturalism in American literature to the beginning of World War I, literary works and their social and cultural contexts, Dickinson, Twain, James, Robinson, Crane.

363. **American Literature since World War I.** (3-0) Cr 3. F S. Alt. SS. *Prereq. 105.* American literature of the twentieth century; literary works and their social and cultural contexts.

366. **Studies in Drama.** (3-0) Cr 3 each time taken, maximum of 6. *Prereq: 105.* Selected topics in the study of drama. Examination of important themes, genres, dramatists, and periods.

367. **Modern Drama.** (3-0) Cr 3. *Prereq: 105.* Origins and development of modern theatre, readings in the works of American, British, and Continental dramatists.

370. **Shakespeare.** (3-0) Cr 3. F S SS. *Prereq. 105.* Reading and analysis of selected plays. Development of Shakespeare's dramatic art in its social and intellectual context.

373. **English Literature of the Middle Ages.** (3-0) Cr 3. *Prereq: 105.* Introduction to medieval literature (*Beowulf* through the fifteenth century), considered in the social and intellectual context of the period.

374. **English Literature of the Renaissance.** (3-0) Cr 3. *Prereq: 105.* Introduction to Renaissance literature (More to Milton), considered in the social and intellectual context of the period.

375. **English Literature of the Restoration and Eighteenth Century.** (3-0) Cr 3. *Prereq: 105.* Introduction to Restoration and eighteenth-century literature (Dryden to Johnson), considered in the social and intellectual context of the period.

376. **English Literature of the Romantic Period.** (3-0) Cr 3. *Prereq: 105.* Introduction to Romantic literature (Blake to Byron), considered in the social and intellectual context of the period.

377. **English Literature of the Victorian Period.** (3-0) Cr 3. *Prereq: 105.* Introduction to Victorian literature (Carlyle to Hardy), considered in the social and intellectual context of the period.

378. **English Literature of the Modern Period.** (3-0) Cr 3. *Prereq: 105.* Introduction to British literature of the twentieth century (Conrad to Auden), considered in the social and intellectual context of the period.

384. **Modern Fiction.** (3-0) Cr 3. *Prereq: 105.* Works of fiction by major American, British, and Continental writers in the twentieth century. Trends, techniques, intellectual concerns; standards for evaluation.

388. **Modern Poetry.** (3-0) Cr 3. *Prereq: 105.* A cross-cultural reading in the major poets of this century: Yeats, Frost, Rilke, Eliot, and others.

389. **Contemporary Literature.** (3-0) Cr. 3. *Prereq: 105.* Studies in fiction, poetry, or drama of the last two decades. Emerging trends and techniques; intellectual concerns.

391, 392. **The English Novel to 1900.** (3-0) Cr. 3 each. 391: Alt. Yr., offered 1981. 392: Alt. Yr., offered 1982. *Prereq: 105.* 391: Development of the English novel to 1832. 392: The Victorian novel. (See 582, 583.)

394. Literature of Adolescence. (3-0) Cr. 3 *Prereq 105* Literature for and about the adolescent. Critical study and evaluation of the genre, examination of modes and themes found in the literature; study of the relationship of the genre to literature for children and adults Selection of literature for use in school programs

395. Reading for Secondary School Teachers. (3-0) Cr 3 *Prereq: 219* Basic instruction in the relationship between language development and reading, in the identification of reading skills and deficiencies, and in techniques for textbook reading Practice in interpreting tests and in measuring the readability of printed texts

400. Studies In Film. (Sp 400) (4-0) Cr 2 to 4 each time taken, maximum of 6 *Prereq One 3-credit course in film, junior classification* Approaches to film, analysis of individual film styles, themes, genres, directors, esthetic and cultural significance of fiction and nonfiction films Fee

404, 405, 406. Creative Writing Workshop. (3-0) Cr 3 each time taken, maximum of 6 *Prereq 404 304, 405. 305, 406 306* Individual projects in creative writing Emphasis on advanced writing techniques, workshop criticism, and individual conferences 404 Fiction Workshop, 405 Nonfiction Workshop, 406: Poetry Workshop

414 Writing of Professional Papers and Reports (3-0) Cr 3 F S SS *Prereq 105, junior classification* Writing of business, technical, or research papers and reports, including a major analytical report, on topics from the student's discipline

419. English Syntax. (3-0) Cr 3 *Prereq 219 or an introductory course in linguistics* Theories and methods for analysis of English syntax with emphasis on transformational grammar (See 516)

420 History and Dialects of the English Language (3-0) Cr 3 *Prereq 105, junior classification* Background and development of the English language Relationships of English to other languages of the past and present Linguistic change, current developments in English vocabulary, structure The regional and social dialects of American English

449. Literary Criticism and Its Application. (3-0) Cr 3 *Prereq 9 credits in English beyond 105* Study of selected texts of literary criticism, with attention to the purposes and uses of critical concepts

473. Chaucer. (3-0) Cr 3 Alt Yr *Prereq 105, 373 recommended The Canterbury Tales* and selected works read in Middle English, considered in the social and intellectual context of the fourteenth century

474. Milton. (3-0) Cr 3 Alt. Yr *Prereq 105, 374 recommended Paradise Lost* and selected minor works, considered in the social and intellectual context of the seventeenth century

489 Undergraduate Seminar (3-0) Cr 3 each time taken F S *Prereq 9 credits in English beyond 105* Intensive study of a selected topic in literature, criticism, or language

490 Independent Study Cr var *Prereq 9 credits in English beyond 105, junior classification, permission of department executive officer* Designed to meet the needs of students who wish study in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields
A Literature
B Linguistics, Semantics
C Rhetoric, Teaching of Composition
D Criticism and Theory of Literature
E Reading Methods and Research
H Honors

494. English in the Secondary Schools. (3-0) Cr 3 F S *Prereq Admission to teacher education program, Psych 333, 15 credits in English beyond 105* The nature of language arts and their relationship to student growth, goals, approaches, materials common to language arts study in the secondary schools, emphasis on a student-centered approach to teaching English Preparation and evaluation of teaching materials

495. Teaching English to Speakers of Other Languages: Methods and Materials. (3-0) Cr 3 *Prereq 219 or an introductory course in linguistics* Teaching grammar, reading, writing, listening comprehension, speaking, and pronunciation Testing and evaluation Open to graduate students in English for major graduate credit

496. Composition and Rhetoric for Teachers. (4-1) Cr 3 8 weeks *Prereq 494* Current theory and practice in the teaching of writing to secondary school students Designing assignments, evaluating writing, analyzing errors, and teaching syntactic and rhetorical skills

497. Supervised Tutoring in Reading. (2-6) Cr 3 *Prereq 395 or comparable course in reading* Practical experience in developing methods for teaching reading in a tutorial situation Assignment to a series of private tutoring sessions with a student who has requested or shows need for special help in reading skills Consultation and seminar meetings with staff supervisor

498. Supervised Tutoring in Composition. (2-4) Cr 3 *Prereq Permission of instructor* Evaluating and developing materials for tutoring purposes Practical experience in teaching writing on a person-to-person basis

499. Supervised Tutoring in English as a Second Language. (2-5) Cr 3 *Prereq 495.* Practical experience in developing methods and materials for teaching English as a second language Assignment to assist an instructor in a class in the IEOP or EFL programs, or assignment to a series of private tutoring sessions with a student who has requested or shows need for special assistance Consultation and meetings with staff supervisor

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

503. Teaching Composition: Approaches to Writing and Rhetoric. (3-0) Cr 3 or 4 *Prereq Undergraduate major or certification to teach English* Current practices and problems in teaching composition at the secondary, junior college, and college levels Preparation of assignments, evaluation of papers, syntactic and rhetorical analysis, theories of the composing process with applications

504 Advanced Imaginative Writing Cr 1 to 3 each time taken, maximum of 9 *Prereq 404 and submission of portfolio to instructor well before the course begins* Individual projects on a workshop and conference basis

505 Theory and Pedagogy of Reading (3-0) Cr 3 *Prereq 3 credits in linguistics, psycholinguistics, or language acquisition* Theoretical models and research developments in reading Practice with standardized, informal, and diagnostic instruments for measurement of reading Implications for teaching reading in secondary schools

507 Professional and Occupational Writing. (3-0) Cr 3 *Prereq 302 or 414* Writing and analysis of documents prepared in business, science, and industry reports, manuals instructions, etc Individual projects directed to improving writing skill or to training in editing and teaching Guided readings

511 Introduction to General Linguistics (3-0) Cr 3 F, Alt SS *Prereq 3 credits in linguistics* Principles of general linguistics, history of the development of modern linguistic science

512 Historical Linguistics and Language Classification (3-0) Cr 3 S Alt SS *Prereq 3 credits in linguistics or in British literature before 1600.* English historical linguistics Genealogical and typological classification of languages

514. Regional and Social Dialects of American English. (3-0) Cr 3 *Prereq 3 credits in linguistics* English at the time of early settlement, non-English influences, American dialect geography, Black English, social variation in present-day American English, pedagogical implications

515 Phonology. (3-0) Cr 3 *Prereq 511 or an introductory course in linguistics* Theoretical and practical analysis of the sound systems of languages, with an emphasis on English phonology

516. (419 DL) English Syntax. (3-0) Cr 3 *Prereq 3 credits in linguistics* Graduate study in conjunction with English 419 May not be taken by students who have previously earned credit in English 419 Additional readings, term project, and special examination for students who enroll for 516

517 Theoretical Foundations for Teaching English to Speakers of Other Languages. (3-0) Cr 3 *Prereq 511 or an introductory linguistics course* Theoretical issues and research in second language acquisition related developments in theoretical linguistics, psycholinguistics, and language pedagogy (For TESOL methods course, see 495)

521. Teaching Literature and the Literature Curriculum (3-0) Cr 3 *Prereq. 9 credits in literature* Examination of the roles of the literary work, reader, and teacher in literary study Responses to literature Place of literature in language arts Study and development of curriculum materials for varied levels of instruction

522. Literary Criticism. (3-0) Cr 3 *Prereq 9 credits in literature* Introduction to the major approaches to literature

530. Research and Bibliography. (3-0) Cr 3 F, Alt SS *Prereq 12 credits in English* Required of candidates for the M.A degree in English

532. Satire. (3-0) Cr 3 *Prereq 6 credits in literature* Selected major texts of satire in the Anglo-American tradition Study of the major critical theories of the genre

534. Science and Literary Imagination. (3-0) Cr 3 each time taken, maximum of 6. *Prereq 6 credits in literature* Literature and science considered as complementary expressions of basic cultural paradigms Close attention to imagery, metaphor, and theories of literary language Alternate offerings emphasize Newtonian (17th-19th centuries) and modern (19th-20th centuries) periods

546, 547, 548 Twentieth Century Literature. (3-0) Cr 3 each time taken, maximum of 6 each *Prereq 6 credits in literature* 546 Selected poets, studied singly or in combination 547 Selected writers of fiction, studied singly or in combination 548 Selected dramatists studied singly or in combination

563. American Fiction to 1900 (3-0) Cr 3 each time taken, maximum of 6 *Prereq 6 credits in American literature* Selected writers in combination, such as Hawthorne and Poe, Twain and Howells, Melville and James

564. Significant American Nonfiction (3-0) Cr 3 each time taken, maximum of 6 *Prereq 6 cr in American literature* Material studied alternates between transcendentalism as a force in American literature, and trends in American nonfiction since 1840

566. American Poetry to 1900. (3-0) Cr 3 each time taken, maximum of 6 *Prereq 6 credits in American literature, including 361* Selected poets in combination

570 Renaissance English Literature (3-0) Cr 3 each time taken, maximum of 6 *Prereq 6 credits in English literature, 374 recommended* Studies of non-dramatic literature of the 16th and early 17th centuries, alternating between emphasis on the early Renaissance and on the later Renaissance

571 Restoration and 18th Century British Literature (3-0) Cr 3 *Prereq 6 credits in English literature, preferably 374, 375* Selected poetry and prose

572 British Drama to 1714 (3-0) Cr 3 each time taken maximum 6 *Prereq 6 credits in literature, preferably 373, 374* Studies of selected non-Shakespearean dramas, alternating between emphasis on the earlier and on the later parts of the period

574 Chaucer (3-0) Cr 3 *Prereq 6 credits, 373 recommended* Intensive study of selected *Canterbury Tales* and minor poems Introduction to Chaucer scholarship

575 Milton. (3-0) Cr 3 *Prereq 6 credits, 374 recommended Paradise Lost,* with other selections from the poetry and prose Introduction to Milton scholarship

576. Nineteenth Century British Literature. (3-0) Cr 3 each time taken, maximum of 6 *Prereq 6 credits in English literature, 376 or 377 recommended* Studies of selected poets and prose writers of the 19th century usually alternating between emphasis on the Romantic period and emphasis on the Victorian period

580 Shakespeare. (3-0) Cr 3 *Prereq 6 credits in English literature prior to 1800* Shakespeare as poet and dramatist Chief critical schools and areas of scholarship

582. (391 DL) The English Novel to 1832. (3-0) Cr 3 *Prereq 6 credits in English literature* Graduate study in conjunction with English 391 Additional readings, project, and special examination for students who enroll for 582 May not be taken by students who have previously earned credit in English 391

583. (392 DL) The Victorian Novel. (3-0) Cr 3 *Prereq 6 credits in English literature* Graduate study in conjunction with English 392 Additional readings, project, and special examination for students who enroll for 583 May not be taken by students who have previously earned credit in English 392

589. Seminar Cr var *Prereq: 12 credits in literature, linguistics, or rhetoric (excluding 104-105)*
A Literature, Criticism
B Linguistics
C Rhetoric; Composition
D Pedagogy

590. Special Topics. Cr var *Prereq Permission of the department executive officer, according to guidelines available in the department office*
A Literature, Criticism
B Linguistics
C Rhetoric, Composition
D Pedagogy

699 Research

Entomology

Paul A Dahm, Chair of Department

Professors: Dahm, DeWitt, Guthrie, R E Lewis, Mutchmor, Pedigo, Rowley, Stockdale

Emeritus Professor: Brindley

Associate Professors: Foster, Hart, Jarvis, Krafsur, L C Lewis, Showers, Tollefson

Assistant Professors: Coats, D R Lewis, Quisenberry, Mertins

Adjunct Instructors: L A Buntin, Trump

Undergraduate Study

For undergraduate curriculum in entomology, see *College of Agriculture, Curricula*

The undergraduate curriculum in entomology is designed for persons interested in studying insects, the ways in which they live, and the practicalities of dealing with them Students electing entomology as a major will prepare themselves for positions in industry, business, government, education, and public health Graduates may acquire positions in research, development, and technical sales for agricultural chemical companies State and federal agencies employ entomologists as consultants, extension directors, mosquito abatement agents, inspectors, and research aides Entomologists may also find employment as consultants with pest-management consulting firms, large private farms and ranches, and horticultural nurseries

Students who are planning to enter agricultural occupations dealing with insect control are advised also to elect the pest-management secondary major Pest management is an undergraduate secondary major that can be taken with entomology in a double-major program (see *Pest Management).*

A preveterinary program is available in entomology

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with major in entomology Within the major, the student may specialize in behavior, biological control, ecology, economic entomology, host plant resistance, medical entomology, morphology, pathology, pest management, physiology, systematics, or insecticide toxicology

Prerequisite to major and minor graduate work in the department is completion of at least two years of zoological courses, for part of which credit in other closely allied biological sciences may be substituted Specific course requirements for advanced degrees depend partly upon previous training and experience in the major field of specialization.

Any student receiving a graduate degree in entomology shall have one course in at least three of the following areas for the M S degree and one course in each of the following areas for the Ph D degree insect morphology, systematic entomology, insect physiology, and insect ecology Equivalents of these courses taken at other universities will be acceptable

The Federal Corn Insects Research Unit at Ankeny is available for advanced study in certain phases of entomological research

The department participates in the interdepartmental programs of Immunobiology and Molecular, Cellular and Developmental Biology (see Index)

Open to graduate students for minor credit only 370, 376

Courses Primarily for Undergraduate Students

110 Technical Lecture (1-0) Cr R F Orientation to areas of and opportunities in entomology

111 Insects and Man — Biological Considerations. (3-0) Cr 3 S Mertins Biological and ecological aspects of the insect world Beneficial and harmful insects Impact of chemical and alternative methods of control Voluntary field trips Primarily for non-life-science majors

222. Beekeeping (2-6) Cr 2 F, first 8 weeks S, last 8 weeks Trump Natural behavior of bees as it relates to honey production and crop pollination Practical experience in managing colonies and removing honey

370 General Entomology (2-3) Cr 3 F S *Prereq Zool 206, 206L* Hart, Krafsur Structure, physiology, evolution, behavior, life histories and recognition of insects Voluntary field trips

374 Medical and Veterinary Entomology (3-0) Cr 3 S *Prereq 6 credits in biological sciences* Rowley The biology and ecology of insects that affect the health of people and animals, including the natural history of disesaes common to people and animals

376 Fundamentals of Entomology and Pest Management. (P M 376) (2-3) Cr 3 S *Prereq Biol 110* Coats, Pedigo Introduction to entomology and insect-pest management, including biology, ecology economics, and tactics of population suppression

416 Forest Pest Management. (PP SW 416) See *Plant Pathology, Seed and Weed Sciences*

490 Independent Study Cr 1 to 3 each time taken *Prereq 15 credits in zoological sciences and permission of instructor*
E Research or work experience
U Laboratory teaching experience For students registering to be undergraduate laboratory assistants

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

500. Seminar. Cr 1 F S *Prereq Permission of instructor* Reports of research and current literature

544 Advanced Forest Pest Management. (PP SW 544) See *Plant Pathology, Seed and Weed Sciences*

570 Host Plant Resistance to Insects (2-0) Cr 2 Alt S offered 1982 *Prereq 370 or 376* Tollefson Principles and mechanisms of insect control by host plant resistance

572 Insect Morphology (2-6) Cr 4 F *Prereq 15 credits in zoological sciences, including 370* Hart Intensive study of the functional anatomy of insects

573 Economic Entomology (2-6) Cr 4 F *Prereq 370* Tollefson Contemporary concepts of insect biology and insect population management

574. Medical Entomology (2-6) Cr 4 F *Prereq 9 credits in biological sciences* Rowley Identification biology, and significance of insects and other arthropods that attack people and animals, particularly those that are vectors of disease Field trips

575 Biological Control (3-0) or (3-3) Cr 3 or 4 Alt F, offered 1981 *Prereq 370, permission of instructor* Mertins Theory and practice of biological control of insects and other pests, biology and behavior of entomophagous insects, entomogenous nematodes and pathogenic microorganisms review and critique of important world projects

576. Systematic Entomology. (3-6) Cr 5 S *Prereq. 370* Classification, distribution and natural history of insects including fundamentals of nomenclature and taxonomic practice Field trips when practical

577 Immature Insects. (2-6) Cr 4 Alt F, offered 1982 *Prereq 576* Lewis Taxonomy, distribution and natural history of immature insects including techniques of collection and preservation Field trips when practical

590 Special Topics. Cr 1 to 3 each time taken *Prereq 15 credits in zoological sciences, permission of instructor*
E Special research topics
T Internship experience in the techniques of organizing and disseminating applied entomological information
U Teaching experience

Courses for Graduate Students, major or minor

655 Insect Physiology (Zool 655) (3-6) Cr 5 S *Prereq 370, Zool 355* Mutchmor Life processes of the insects, including reviews of current problems in insect physiology

671 Insect Ecology and Pest Management. (2-3) Cr 3 Alt S, offered 1983 *Prereq 370, Biol 309, Stat 401* Pedigo Concepts of insect population dynamics, emphasizing sampling, outbreaks, analysis, bioeconomics, and management systems

674 Advanced Medical Entomology. (1-6) Cr 3 Alt S, offered 1982 *Prereq 574* Rowley Vector-parasite relationships, ecology, and epidemiology of arthropod-borne animal diseases

675. Insecticide Toxicology (3-0) Cr 3 Alt F, offered 1981 *Prereq 572, 655* Coats, Dahm Principles of insecticide toxicology, classification, mode of action, metabolism and environmental effects of insecticides

699 Research

Environmental Studies

(Interdepartmental Undergraduate Program)

Craig B Davis Coordinator

Professors: Gratto, Hodges, O'Toole, Sinatra

Associate Professors: Hollenbach, Rosauer, Tanner

Assistant Professor: Richardson

The Environmental Studies Program is designed for students interested in improving their understanding of environmental problems and the varied factors influencing the development and solution of these problems, or for students desiring careers in environmental science, environmental technology, environmental planning and management, environmental assessment, or environmental education The program is designed to give the student an appreciation of the environment and an overview of environmental problems and their solutions The over-all structure and philosophy of the program are designed to provide an atmosphere in which interdisciplinary breadth may be combined with disciplinary depth in the quest for solutions to environmental problems

The program has two facets a required core and a student-designed area of emphasis (AOE) The core incorporates 11 credit hours of course work and is designed to acquaint students with the intricate, interdisciplinary nature of environmental problems (Env S 221, 222, 391, 421) The area of emphasis consists of 20 credit hours of course work and is designed to allow students to individualize programs to

suit particular desires and goals. Courses for the AOE are selected from disciplinary courses taught by various departments on campus.

Research and independent study activity are encouraged. Students may include up to 4 hours of 290E or 490E in their AOE's. These activities may include internship experiences when approved in advance by the coordinator of environmental studies

The combined core and area of emphasis must include a minimum of 20 credits of courses numbered 300 or above.

Students in any college of the University may enroll in the Environmental Studies Program by registering with the coordinator of the program and developing an appropriate area of emphasis. Completion of the program is recognized by a statement to that effect which is entered on the student's transcript

Students in the College of Education and the College of Sciences and Humanities may enroll in environmental studies as a second major (See *Education* and *Sciences and Humanities Cross Disciplinary Studies.)*

Open to graduate students for minor credit only. 421, 425

Courses Primarily for Undergraduate Students

221. Introduction to Environmental Studies. (U St 221) (3-0) Cr 3 F *Prereq Sophomore classfication* The structure and dynamics of environmental systems, social and ecological Basic ecology, the role of information, material resource availability and use, energy resource availability and use, and pollution of air, water and land

222. Introduction to Environmental Studies. (U St 222) (3-0) Cr 3 S *Prereq Sophomore classification.* Human population structure and growth, the world food problem, production and consumption patterns in ecosystems and social systems, cultural approaches to the environment, and the growth vs no growth controversy Emphasis on factors affecting decision making.

225. Introduction to Environmental Education. (U St 225) (2-2) Cr 3 F Goals, issues, and instructional materials in environmental education Field experience with teachers and children Environmental education as a multidisciplinary endeavor Environmental education in non-school agencies. Contemporary environmental education compared with outdoor education, nature study, and conservation education

290E. Special Problems. (U St 290E) Cr Arr *Prereq. Permission of the Coordinator of the Environmental Studies Program and the Vice President for Academic Affairs.* Independent study on topics of an interdisciplinary nature. Intended primarily for freshmen and sophomores.

391. Seminar in Environmental Studies. (U St 391) (1-0) Cr 1 F S. *Prereq: Junior classification* Seminar discussions of various topics of environmental concern

421. Policies and Procedures in Environmental Analysis. (U St 421) (2-2) Cr 3. F *Prereq: 221, 222.* History of environmental legislation and the development of environmental assessment. Interrelationships among federal, state, and local agencies, the public and the courts in implementing environmental laws and regulations. Techniques for the analysis and preparation of environmental impact statements under the National Environmental Policy Act. Field trips.

425. Environment and Society. (U St 425) (3-0) Cr 3 SS *Prereq: 10 hours in social or natural sciences* An in-depth analysis of natural and human-modified ecosystems with attention on energy, resources, food, and population as they relate to society and the quality of human environments.

490E. Independent Study. (U St 490E) Cr Arr *Prereq: Permission of the Coordinator of the Environmental Studies Program and the Vice President for Academic Affairs.* Independent study on topics of an interdisciplinary nature. Intended primarily for juniors and seniors.

Family Environment

Edward A. Powers, Chair of Department

Professors: Bivens, Deacon, Heltsley, Peet, Pickett, Powers, Schwieder

Emeritus Professors: Budolfson, Liston

Associate Professors: Cole, Jeries, Meredith, Morris, Rippie, Strong, Weltha, Winter

Assistant Professors: Allen, Bishop, Denzin, Hira, Jones, Mercier, Norem, Wedin, Yeams

Instructors: Enders, Huffman, Needles-Fletcher

Undergraduate Study

For undergraduate curriculum in family environment leading to the degree bachelor of science, see *Home Economics, Curricula.*

The Department of Family Environment offers courses that explore ways in which families and individuals develop and allocate human and material resources to achieve individual and family goals. The department offers work for the degree Bachelor of Science with curricula in family resource management, family services, and housing and the near environment.

The family resource management curriculum focuses on the behavior of families as they allocate and manage their resources and function as consumers. The curriculum leads to employment with agencies and organizations that are concerned with family financial management, consumer economics, and analysis and implementation of public policies that affect family resource management

The family services curriculum leads to work in the helping services Employment opportunities exist in public and private agencies Examples include services to the elderly, youth services, community action, community planning, rehabilitation, health care, family services, and crisis intervention

The curriculum in housing and the near environment includes emphases in home furnishings, housing, and household equipment Graduates of this curriculum find employment with business and industry, private agencies, and federal, state, and local governments

Graduate Study

The department offers the degree of Master of Science with a major in family environment, and the Ph.D. degree as a joint major with another field such as chemistry, child development, economics, education, food and nutrition, home economics education, physics, sociology, and anthropology A family environment minor is available for Ph.D students majoring in other departments

The department cooperates in the interdepartmental programs of Housing, Gerontology, Technology and Social Change, and Water Resources (see Index)

Prerequisite to major work in family environment is the completion of at least 10 credits in each of the following areas. communicative arts, humanities, physical and biological sciences, and social and behavioral sciences. The student should also have the equivalent of the courses generally considered as introductory principles in the family environment program at this institution. Educational background in the physical and/or social sciences may be suitable, depending on the student's objectives.

Guidelines for graduate programs of study in family environment have been developed. However, the student's program of study committee has the major responsibility for determining requirements for an individual program.

Open to graduate students for minor graduate credit only. 408, 410, 412, 415, 446, 471, 479, 488.

Courses Primarily for Undergraduate Students

185. Families and Their Environment. (3-0) Cr 3. F S Exploration of the interaction of families with the social economic, physical, and political dimensions of the environment over time

201. Family Life Development. (C D 201) (3-0) Cr 3 F S SS A study of the dynamic processes of co-development of families and individuals, both normal and exceptional Patterns of self-development and life-span development with focus on the interaction between and among individuals

240. Introduction to Housing. (2-1) Cr 3 F S Physical cultural, economic, social, and personal conditions that affect family housing Factors related to differences in housing needs

308. Lighting for Residential Interior Living Spaces (2-1) Cr. 3. F. *Prereq. 3 credits in housing* Criteria for lighting interior living spaces to meet needs of individuals and families Emphasis on light for general, task, and aesthetic effects Light sources, wiring, and techniques to implement design objectives and conserve energy

341. Housing Finance. (3-0) Cr 3 F *Prereq 240, Econ 201* Personal and family financial consideration in home ownership, rental, and home improvement The social, economic, and governmental context of financial decision making at the household level

354. Equipment in the Home. (3-0) Cr 3 F S *Prereq Junior classification or 3 credits in physics* Utilization of water, electricity, gas, light, and heat for doing work and maintaining health, safety, and comfort in the home environment Selection and use of portable and major appliances as related to consumer needs, interests, and resources. Application of basic physical science principles

360. Rehabilitation Principles and Services. (2-0) Cr 2 F SS *Prereq: 6 credits in family environment, sociology, or psychology* Principles related to physical, social, psychological, economic, and intellectual limitations of individuals with disabilities Role of family as support system Programs and activities designed to assist disabled in home and community

370. Personal and Professional Communication. (3-0) Cr 3 F S *Prereq: Junior classification.* An analysis of functional communication patterns with a professional orientation toward understanding and implementing communication skills in interpersonal, family and professional relationships

370L. Laboratory in Communication Skill Development. (0-2) Cr 1 F.S. *Prereq: Classification in 370.*

373. Death as a Part of Living. (2-0) Cr 2 S *Prereq 201* Consideration of death in the life span of the individual and the family with opportunity for exploration of personal and societal attitudes Field trip Fee

377. Aging and the Family. (2-0) Cr 2. F *Prereq. 201* Interchanges of the aged and their families Emphasis on role changes, social interaction, and independence as influenced by health, finances, life styles, and community development.

378. Family and Management Patterns. (2-1) Cr 3 F S *Prereq. 201, Soc 134, Econ 201.* The use of family and management theory in understanding family behavior and patterns

380. Family Law. (3-0) Cr 3 S *Prereq: Junior classification* Family relationships, rights, and duties as prescribed by law Investigation of sources and interpretations of law

391. Family and Community Assessment. (3-0) Cr 3 F S. First 8 weeks. *Prereq: 370; 6 credits in sociology, psychology or family environment; junior classification* Prepracticum training for methods and skills needed to function as professionals. Development of case studies, interpretation of census data findings, identification of key community leaders, agencies, or business contacts, and other methods contributing to family and community needs assessment

408. **Care of Modern Fabrics.** (3-0) Cr. 3 S *Prereq: 3 credits in textiles or household equipment* Application of basic physical and chemical principles to effective clothing care Analysis of appliance design, materials, and procedures for fabric care Emphasis on resource conservation Review of research and current literature

410 **Food-Related Major Home Appliances.** (2-4) Cr. 3. F *Prereq 354, laboratory in Chem, F N or Phys* Design and performance of freezers, microwave ovens, ranges, and refrigerators Use and evaluation in terms of utility to consumer

412. **Kitchen, Bath, and Utility Area Planning.** (2-2) Cr 3 S *Prereq. 6 credits in housing, art and design, or architecture* Criteria for planning of kitchen, bath, utility areas Application of human engineering principles for effective functioning in work areas Emphasis on economy, resource conservation, and space adaptation

415. **Families as Consumers.** (3-0) Cr 3 F S *Prereq 3 credits in psychology, 3 credits in sociology, Econ 201* Theories of consumer behavior; the family's relationship to the consumer movement, consumer issues, dimensions of consumer role, interaction of consumers, government and the market, consumer decision making, evaluation of information and protection

425. **Seminar.** Cr 1 to 3 F S
A Family Relations and Human Development
B Housing
C Consumer Economics and Management
D Household Equipment
G General Family Environment
L Legal Environment
R Rehabilitation

446. **Housing Alternatives for Individuals and Families** (2-4) Cr 3 F *Prereq 240* Meeting human needs at various stages of the life cycle through alternative housing forms Emphasis on internal housing environment as influenced by social, technological, and physical factors Field trip Fee

471 **Family Analysis and Planned Change.** (2-1) Cr 3 S *Prereq 378, 391* Application of theory and methods to the analysis of individual and family problems. Integration of problem-solving approaches

479 **Family Interaction Dynamics.** (3-0) Cr 3 F *Prereq 370, 378* Analysis of family interaction processes and patterns with emphasis on relationship dynamics

488 **Family Financial Management.** (2-2) Cr 3 F S *Prereq 201 or 3 credits in psychology, 3 credits in sociology, Econ 201* Family financial management as affected by interrelationships between society and families Decision making relative to acquiring and allocating income Financial management focused on borrowing, taxes, housing, insurance, savings, investments, retirement, and estate planning

490 **Independent Study** Cr arr *Prereq 12 credits in applicable courses, permission of instructor* Consult department office on procedures for filing a written plan of study
A Family Relations and Human Development
B Housing
C Consumer Economics and Management
D Household Equipment
F Field Trips and Field Experience
G General Family Environment
H Honors
L Legal Environment
R Rehabilitation

491 **Practicum.** Cr 8 F S SS Second 8 weeks *Prereq 391, permission of instructor Reservation required one semester before placement* Supervised work experience off campus with a consumer or family agency or business

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates.

500 **Short Course.** Cr arr Designed primarily for special groups Not accepted for graduate credit in family environment.
A Family Relations and Management
B Housing
C Consumer Economics and Management
D Household Equipment
G General Family Environment

501 **Graduate Study Orientation.** (1-0) Cr 1 F Orientation to graduate study and current research in the department

504. **Research Methods and Techniques.** (3-0) Cr 3 S *Prereq: 9 credits in social sciences* Research methods and techniques applicable to studies of families and households Emphasis on the solution of practical problems of analysis using SPSS, WYLBUR, and other programs

510. **Technological Development and the Environment of the Family** (3-0) Cr 3 Alt S, offered 1983 *Prereq 3 credits of 500-level courses in family environment* Technology as a force influencing and influenced by individual and family needs Implications of technological change on life styles Intensive analysis of technological concepts, assumptions, and interpretations.

519. **Consumer Dynamics.** (3-0) Cr 3 Alt S, offered 1983 *Prereq. 415, 488, Econ 401* Consumer roles in the evolution of economic society Analysis of consumer interactions with public and private institutions serving consumer interests Emphasis on process of consumer decision making

521. **Housing and the Social Environment.** (3-0) Cr 3 F *Prereq 504 and 6 credits in sociology* Housing adjustment behavior of individuals and families in the context of the social and cultural framework of society Impact of housing on the family

522. **Time and Human Resources.** (3-0) Cr 3. Alt S, offered 1982 *Prereq. Econ 401* Conditions, programs, and policies related to development and allocation of human resources and time, with special reference to impact on families and households

523. **Management within the Family.** (3-0) Cr 3 F *Prereq 378, 6 credits in sociology or economics* Theoretical developments and research related to the use of family resources to achieve family goals Emphasis on systems theory as applied to family management

540. **Energy in the Residential Environment.** (2-0) Cr 2 Alt S, offered 1982 *Prereq 9 credits in social and/or physical sciences* Factors affecting availability and use of energy in the home

565. **Pragmatics of Family Communication.** (3-0) Cr 3 F *Prereq 6 credits in behavioral sciences* Influence of communication including language and cultural aspects in family relationships Emphasis on functional interpersonal communication in maintenance of holistic health of family members.

570 **The Individual and Family Development.** (3-0) Cr 3 S *Prereq 9 credits in behavioral sciences* Experiential learning and encounter with contemporary theories of human potential in individual and family living

575. **Cultural Foundations of Family Life.** (3-0) Cr 3 Alt F, offered 1982 *Prereq 378* Cultural influences in individual and family development Comparison of family roles, values, customs, taboos, and rituals in contrasting cultures

577 **Aging and Intergenerational Relations.** (3-0) Cr 3 Alt S, offered 1982 *Prereq 378, Psych 230, Soc 305* Personal and family adjustments to role changes in later life that affect older persons and their adult children

578. **Family Theory.** (3-0) Cr 3 S. *Prereq 12 credits in behavioral sciences* Analysis of conceptual frameworks in the area of the family by examining their development, concepts, assumptions, inadequacies, and contradictions

579. **Family Dynamics.** (3-0) Cr 3. F *Prereq. 479 or Soc 485* A psychosocial analysis of intrafamilial interaction processes and patterns with an emphasis upon relationship issues such as emergent roles and power

580. **The Family and the Law.** (3-0) Cr 3 SS *Prereq 415 or 488 or Mgmt 315* Examination of the effects of selected legislation and cases on individuals and families Discussion of the legal processes involved in the activities of individuals and families Implications for effective functioning within the limits of the legal environment. Investigation of legal and quasi-legal services available in a community

588. **Family Economics.** (3-0) Cr 3 F *Prereq. 415, 488* Problems of measuring family income, wealth, and welfare Programs for improving adequacy and security of income during family life cycle Factors which influence standards and levels of living

590. **Special Topics.** Cr arr *Prereq. Permission of instructor.* Consult department office on procedure for filing a written plan of study
A Family Relations and Human Development
B Housing
C Consumer Economics and Management
D Household Equipment
F Field Trips and Field Experience
G General Family Environment

591. **Practicum in Family Environment.** (as arr) Cr 1 to 6 each time elected *Prereq. 10 graduate credits Supervised experience in the following areas of family environment*
A Family Relations and Human Development
B Housing
C Consumer Economics and Management
D Household Equipment
G General Family Environment

Courses for Graduate Students, major or minor

604. **Seminar.** Cr 1 to 3. F S
A Family Relations and Human Development
B Housing
C Consumer Economics and Management
D Household Equipment
G General Family Environment

676. **Family Therapy.** (3-0) Cr 3. Alt. F, offered 1981 *Prereq 565, 578.* Application of family and counseling theory to the process of therapeutic intervention with families Emphasis on systems dynamics orientation

699. **Research.** Cr arr
A Family Relations and Human Development
B Housing
C Consumer Economics and Management
D Household Equipment
G General Family Environment

Farm Operation

For information about this curriculum, see *College of Agriculture, Curricula.*

Food and Nutrition

Jacqueline Dupont, Chair of Department

Professors: Brewer, Dupont, Garcia, Hathcock, Olson, Osman, Roderuck

Emeritus Professors: Amrich, Carlin, Eppright, McMillan, Miller

Associate Professors: Kaplan, McComber, T. Runyan, W Runyan

Assistant Professors: Bohnenkamp, Chen, Corey, Hogan, J. Love, M Love, Madden, Munsen, Oakland, Schafer, Serfass, Sizer, Tait, White

Instructors: Benson, Kapfer, Hintz

Undergraduate Study

Courses in food and nutrition acquaint the student with the principles underlying the selection, preparation, and use of food for human health and for the welfare of society. Emphasis is placed on the scientific, cultural, and professional aspects of the broad area of food and nutrition.

The department offers work for the degree bachelor of science with four curricula community nutrition, dietetics, food science, and nutritional science Each of these curricula affords excellent preparation for a variety of employment opportunities. Each of them also provides a basis for graduate study, with nutritional science and option II in food science being particularly appropriate preparation for students who wish to go on for advanced degrees.

The curriculum in community nutrition offers preparation for work as a nutritionist at the entry level in public health, social welfare organizations, extension service, or industry. This curriculum is planned for students interested in helping people everywhere to use

knowledge of nutrition for the betterment of their health. It meets academic requirements for admission to dietetic internships offering specialization in community nutrition.

The curriculum in dietetics offers two options planned for students interested in medical dietetics, food service, and nutrition education. Graduates are prepared for a wide variety of positions in hospitals, clinics, nursing homes, and government nutrition programs. They may work as private nutrition consultants in cooperation with physicians or as nutritionists with food industries. This curriculum meets the academic requirements for membership in the American Dietetic Association; option II (coordinated undergraduate program) also meets the experience requirements for ADA membership.

The curriculum in food science offers two options which differ in emphasis. Option I (consumer food science) serves those who are interested in preparation of food and in food-product development in experimental kitchens or laboratories. It prepares students for careers in food research, food-product development, food-promotion programs, and consumer services in government, business, and industry Option II (food science) provides a strong background for research positions in colleges and universities, government agencies, foundations, and food industries It is particularly good preparation for graduate study

The curriculum in nutritional science offers students excellent preparation for research positions in laboratories of colleges and universities, government agencies, industries, and foundations. It also affords an especially strong background for graduate study

Graduate Study

The department offers work for the degree Master of Science with majors in food science, nutrition, and food and nutrition, and for the degree Doctor of Philosophy with majors in food science and nutrition, and minor work for students taking major work in other departments.

Prerequisite to major work is the completion of a curriculum in food and nutrition substantially equivalent to that required of undergraduates at Iowa State University Students with undergraduate majors in biological and physical sciences also are qualified for graduate study in food science and nutrition.

Students taking major work for the degree Doctor of Philosophy either in food science or in nutrition may choose minors from other fields of home economics as well as from anthropology, chemistry, biochemistry, bacteriology, economics, education, food technology, journalism, psychology, physiology, sociology, statistics, or other related fields.

For the degree Doctor of Philosophy, there is a requirement for (1) demonstration of a satisfactory reading knowledge of two foreign languages or (2) competence in communication in one foreign language as demonstrated by examination or as indicated by two years of course work (C grade or better) in the baccalaureate program. The program of study committee may substitute evidence of a high level of competence in a subject matter area of skill outside the major or minor (such as DVM or MD degree, certification in a technical speciality, skill in an advanced instrumental or computational technology) for the foreign language requirement. The substitution must contribute to doctoral performance and must be approved by the departmental executive officer.

Open to graduate students for minor credit only: 305, 410, 413, 414, 431.

Courses Primarily for Undergraduate Students

107. Human Nutrition. (3-0) Cr 3 F S SS. *Prereq: Biol 109 or 110 or Zool 155.* Understanding and implementing present day knowledge of nutrition; the use of food for health and satisfaction of the individual and the family

***207. Fundamentals of Food Preparation.** (2-3) Cr 3 S *Prereq: 107, Chem 163, 163L; enrollment in the home economics curriculum in hotel and restaurant management or permission of the instructor; advance reservation with the department required* Principles involved in preparation of food products of standard quality. Influence of composition and techniques on properties of food products. Standard methods of food preparation with emphasis on quality, nutrient retention, and safety.

***208. Principles of Food Preparation.** (2-3) Cr. 3. F.S. *Prereq: Credit or classification in 107 and in Chem 231 or 331.* Application of scientific principles in the use and preparation of selected food products

214. Scientific Study of Food. (3-6) Cr 5 F S *Prereq Credit or classification in 107; Chem 231 or 331* Composition and structure of foods; principles underlying preparation of standard quality food products, behavior and interactions of food constituents This course is a prerequisite for the advanced study of food

301. Concepts of Nutrition Science. (3-0) Cr 3. S *Prereq. 107; Chem 231 or 331; Zool 155.* Explanation of the bases of nutrition science; interpretations of interrelationships between food practices and physiological, social, and psychological factors. Not accepted for credit toward a major in food and nutrition

303. Economics and Management of Family Food. (2-3) Cr 3. F.S SS. *Prereq. 107 or 305; 208 or credit or classification in 214, Econ 201* Parameters of family decision-making process focused on fundamentals and trends of the food market economy Management of resources related to feeding the family; consideration of family food patterns and nutritional needs, choice, purchase, preparation, and service of food

304. Sensory Evaluation of Food. (1-3) Cr 2 F *Prereq 208 or 214 or F Tch 101, 102, Stat 101 or 104* Application of principles of sensory evaluation of the quality of foods. Methodology for taste panels. Correlation of data with objective measurements of food quality

305. Nutrition and Dietetics. (3-0) Cr 3 F S. *Prereq. 3 credits in biochemistry and 3 credits in physiology.* Physiological and chemical bases for nutrient needs, factors to consider in satisfying those needs for individuals and populations.

305L. Nutrition and Dietetics Laboratory. (0-3 or 6) Cr 1 or 2 F S *Prereq: Credit or classification in 305.* Laboratory experiences in dietary analysis, metabolic balance, and nutritional status assessment.

320. Sensory and Physical Analysis of Food. (2-3) Cr 3. S. *Prereq. 214; Phys 106 or 111, Stat 101 or 104, advance reservation with the department required* Introduction to sensory perception and the methods used for studying the sensory qualities of food Analysis and interpretation of data from sensory tests. Instrumental methods for measuring physical properties related to sensory response

340. Orientation to Dietetics. (0-2) Cr 1 F *Prereq Admission to the coordinated undergraduate program in dietetics.* Introduction to the roles of dietitians and the health care delivery system.

404. Seminar in Food and Nutrition. (1-0) Cr. 1 F.S. *Prereq. Food and nutrition majors only, 305; senior classification.* Orientation to professional work; state, national, and international problems in food and nutrition

410. Nutrition in Growth and Development. (4-0) Cr 4 F S. *Prereq: 305.* Nutrition during human growth and development with emphasis on interrelations of nutrition and biological functions.

411. Experimental Study of Food. (2-3) Cr 3. F S *Prereq. 214; 3 credits in biochemistry; senior classification.* Application of scientific principles to the solution of problems in food preparation. Not to be taken by majors in food science or students desiring to take 421 and 422

413. Community Nutrition. (2-3) Cr. 3. F S. *Prereq 305* Survey of current public health nutrition problems among nutritionally vulnerable individuals and groups, discussion of the multidimensional nature of those problems and of community programs designed to help solve them and the role of community nutritionists Concurrent field observations Fee

414. Program Development in Community Nutrition (2-3) Cr 3. S. *Prereq: 413* Identification of problems, introduction to planning and evaluation of programs Dietary surveys of small population groups are designed and conducted with faculty guidance Fee

418. Nutrition Education Methods. (1-2) Cr 2 F S *Prereq: Credit or classification in 431, Sp 211 or 212* Methods of group and individual nutrition education as they apply to health care clients, employees, and allied health professionals. Discussion and application of needs assessment techniques, instructional development, documentation techniques, and teaching methods.

421. Experimental Approach in Food Science. (2-6) Cr 4 F *Prereq. 320; B B 301, 311.* Experimental approach to the study of factors influencing behavior of foods

422. Food Product Development. (2-6) Cr 4 S *Prereq 421* Continued experimental approach to the study of factors influencing behavior of foods, guidance and individual experience in planning, executing, and reporting a problem in food research, interpretation and evaluation of pertinent literature

426. Multicultural Food Patterns of Families. (2-3) Cr 3 S. *Prereq: 421, permission of instructor.* Study and preparation of the food and beverage common to and characterizing family foods in other countries

430. Supervised Hospital Experience. Cr 1 or 2 SS *Prereq Senior classification in food and nutrition, advance approval by the departmental executive officer required.* Supervised experience in a hospital dietary department. Fee.

431. Nutrition in Disease. (3 or 4-0) Cr 3 or 4 F S *Prereq: 305* Pathophysiology of selected medical problems with specific attention to nutritional needs and treatment as part of medical therapy

440. Experience in Clinical Dietetics. (0-6) Cr 2 S *Prereq: Classification in 418 and 431, admission to the coordinated undergraduate program in dietetics* Supervised experience in clinical dietetics. Includes needs assessment, nutrition care plan development, documentation, counseling, and teaching Coordinated with 418 and 431.

441. Delivery of Nutritional Care. (2-6) Cr 4 F S *Prereq 340, concurrent enrollment in 442* Analysis of and participation in the processes involved in the delivery of nutritional care

442. Medical Dietetics. (3-9) Cr 6 F S. *Prereq Concurrent enrollment in 441* Biological basis of medical, drug, and diet therapy for selected pathologies. Consideration of factors in planning and conducting nutritional care of patients. Integration of principles with clinical experience

444. Dietetics Seminar — CUP. (1-0) Cr. 1 F S. *Prereq 340.* Identification of issues of concern in the dietetic profession as observed in clinical settings and in the literature

445. Experience in Community Dietetics. (0-6) Cr 2 F S *Prereq: Classification in 410 and 413, admission to the coordinated undergraduate program in dietetics* Supervised experience in planning and providing nutritional care for individuals and groups in a variety of community settings. Coordinated with 410 and 413.

490. Independent Study. Cr arr *Prereq: 305; permission of the departmental executive officer and instructor.*
A. Nutrition
B. Food Science
C. Coordinated undergraduate program in dietetics
H Honors

499. Senior Research. Cr arr each time elected F S *Prereq. 305; B B 404, Chem 211 or B B 311, permission of instructor.* Individual study of methods used in nutrition and food science research with application to selected problems.

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*Credit for both 207 and 208 may not be applied toward graduation.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

500 Short Course. Cr arr SS *Prereq Permission of instructor*

510 Malnutrition in Developing Countries. (2-0) Cr 2 Alt S offered 1983 *Prereq 305 or An S 318* Identification and quantitative assessment of malnutrition in developing countries, social, political, economic, and geographic ecology of malnutrition and its impact on health, protein-calorie malnutrition, vitamin and mineral deficiencies, intervention organizations, programs, and efforts

520 Current Topics in Food Science (2-0) Cr 2 S *Prereq 421, B B 404* Research literature in selected areas of food science

550 Processed Foods. (3-0) Cr 3 S *Prereq 214, 305* Survey of the effects of home and commercial food preparation and processing on the nutrients in food

590. Special Topics. Cr arr *Prereq 305, permission of departmental executive officer and instructor*
A Nutrition
B Food Science
C Professional Problems

Courses for Graduate Students, major or minor

601 Advanced Nutrition. (4-0) Cr 4 S *Prereq 305, B B 404 and credit or classification in B B 405* Principles of human nutrition: Nutrition for energy, body structure and function, nutritional interrelationships, nutrient requirements, status assessment, and availability, nutritional diseases, socio-cultural influences on nutrition

606 Chemical Methods for Research in Food and Nutrition (1-6) Cr 3 F *Prereq 305, Chem 211 or equivalent* Application of chemical techniques to research in nutrition and food science

607 Animal Experimentation in Nutrition Research (1-0 or 6) Cr 1 or 3 S *Prereq 606 or 305 and Chem 211* *The animal feeding experiment as a technique in nutrition research Principles and basic experimental design using small laboratory animals Individual problems in the laboratory animal*

609 Seminar. (1-0) Cr 1 F S Required of all graduate majors in the Food and Nutrition Department

612 Food Lipids. (F Tch 612) (2-0) Cr 2 Alt S, offered 1982 *Prereq 421 or F Tch 411 or B B 404* Structure and analysis of food lipids, glyceride structure, crystal form and texture, autoxidation, refining and processing of fats and oils

613 Food Proteins. (F Tch 613) (2-0) Cr 2 Alt F, offered 1981 *Prereq 421 or F Tch 411 or B B 404* Properties of proteins found in milk, eggs, meat, and cereal grains Effect of processing on food proteins

614 Carbohydrates in Foods (F Tch 614) (3-0) Cr 3 Alt S, offered 1983 *Prereq 421 or F Tch 411 or B B 404* Study of production of carbohydrates used in foods, changes they undergo during processing and storage of food, and relation of their functions to their chemical and physical properties

615. Selected Topics in Nutrition (2-0) Cr 2 each time selected F *Prereq 601* Series of one-term courses on such topics as protein, vitamins, minerals, lipids, energy metabolism, evaluation of nutritional status Classical and current research literature in each area.

619 Research Methods in Food Science. (1-6) Cr 3 F *Prereq 421, Chem 332, Micro 420* Application of physical, chemical, and organoleptic techniques to research in food science Use of experimental design, analysis of data, and review of literature

630. Nutritional Pharmacology and Toxicology. (3-0) Cr 3 F *Prereq 601* Mechanistic and biometric concepts, nutrient toxicities and imbalances, diet-drug incompatibilities, nutritional effects on drug metabolism and cancer etiology, toxicants in the food chain, regulatory policy and philosophy

680 Modern Views of Nutrition (An S 680) See *Animal Science*

699 Research
A Nutrition
B Food Science

Food Technology

W W Marion, Head of Department

Professors: Hammond, Hartman, Kline, Kraft, LaGrange, Parrish, Robson, Rust, Stromer, Walker

Associate Professors: Glatz, Hasiak, Olson, Sebranek, Wilson

Assistant Professors: Hsu, Love, Murphy

Undergraduate Study

For undergraduate curriculum in Food Technology, see *College of Agriculture, Curricula*

Food technology is a curriculum administered by the College of Agriculture It consists of the application of the sciences to the development, manufacture, marketing, and protection of food products The many facets of food technology, such as research, processing, packaging, quality control, marketing, foreign trade, and governmental supervision, create a variety of interesting career opportunities The curriculum is constructed according to the recommendations of professional societies Sufficient electives are included so that a student, after taking a core of basic food technology courses, may minor or specialize in those fields of the food industry that are most attractive

Preveterinary preparation is available through food technology

Students who wish to combine education in engineering with food technology may arrange special five-year programs

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with major in food technology, and minor work for students majoring in other departments Graduate work in meat science is offered as a co-major in animal science and food technology

The department also participates in the interdepartmental programs of Molecular, Cellular, and Developmental Biology, and Water Resources (See *Index.*)

Prerequisite to major graduate work is the satisfactory completion of an undergraduate curriculum essentially equivalent to the food technology curriculum offered in this department or the completion of a curriculum in a related science such as dairy technology, bacteriology, chemistry, biochemistry, or engineering Preparation in biology, chemistry, physics, and calculus along with knowledge of food processing, sanitation, and preservation are particularly desirable for those intending to pursue graduate work.

Courses open to graduate students for minor credit only 301, 302, 360, 401, 402, 405, 410, 411, 421, 425, 493, 494 Exceptions may be made for graduate majors whose undergraduate preparation was not in food technology or food-product technology but in a related science With approval of their graduate committees, they may take 9 hours of food technology courses with 400 numbers for graduate credit

Courses Primarily for Undergraduate Students

101. Food and the Consumer. (3-0) Cr 3 F S. Properties of food constituents. Protection of food against deterioration and microbial contamination Processes for making various foods Government regulations Use of food additives

102. Food Quality Evaluation. (0-3) Cr 1 F S Government standards and quality grade; color, composition, defects, detection of extraneous materials, taste, texture

110 Orientation in Food Technology. (1-0) Cr R F Planning a career in food technology

301 Processing of Dairy Products. (2-3) Cr 3 S *Prereq. 101* Procedures used in making, distributing, and controlling the quality of dairy products Fee for field trips

302. Processing of Fruits and Vegetables. (2-3) Cr 3 F *Prereq. 101 or Hort 371* Harvesting, handling, processing, and storage of fruits and vegetables Current practices and problems Flavor, color, composition, nutritional value and safety of raw and processed fruits and vegetables Fee for field trip

360. Seminar on Contemporary Problems in Food Technology. (1-0) Cr 1 F *Prereq 101*

401. Food Processing. (Micro 401) (3-0) Cr 3 F *Prereq 101, Micro 300* Food preservation, packaging, and quality changes Food fermentations

402. Food Processing Laboratory. (Micro 402) (0-6) Cr 2 F *Prereq 102, Micro 300* Thermal processing, low temperature preservation, packaging methods, food fermentations, use of starter cultures Fee for field trips

405. Food Quality Assurance. (2-0) Cr 2 S *Prereq 410 or 420, Stat 104* Use of biological, chemical and physical analyses to maintain quality and safety Design of food quality control programs and their application to food systems

410 Food Analysis. (1-6) Cr 3 S *Prereq Chem 211, 231 or 331* Proximate, spectrophotometric, and chromatographic methods for food analysis Physical properties

411 Food Chemistry. (2-3) Cr 3 F *Prereq B B 301* The structure properties and reactions of food constituents and commodities

420 Food Microbiology (Micro 420) See *Microbiology*

421 Food Microbiology Laboratory. (Micro 421) (1-6) Cr 3 F S *Prereq Micro 300* Standard microbiological techniques employed in the food industry, including microscopic examination of foods, sampling methods, plate counts, and other enumeration methods, indicator organisms of food quality and safety Fee for field trips

425 Food and Water Sanitation. (Micro 425) (3-0) Cr 3 S *Prereq Micro 300* Control methods and regulations for maintaining sanitation and quality of foods and water

460. Seminar in Food Technology (1-0) Cr 1 S *Prereq Junior classification* Readings and reports from current food technology literature

490. Independent Study. Cr Var Laboratory investigations, assigned readings, and reports on food products and processes

493. Engineering Principles for Food Technology I. (Ag M 493) (2-3) Cr 3. F *Prereq. Math 160; Phys 106 or 111 or 221* Introduction to the principles of food process engineering Applications of basic mechanics, electricity, fluid mechanics and heat transfer to food processing Fee for field trips.

494. Engineering Principles of Food Technology II. (Ag M 494) (2-3) Cr 3 S. *Prereq. 493* Psychrometrics, air conditioning, evaporation, materials handling, drying, and process analysis

Courses primarily for graduate students, major or minor, open to qualified undergraduates.

538. Food Industry Regulations. (2-0) Cr 2 Alt S 1983 *Prereq: Permission of instructor* International, federal, state, and local regulations affecting food product development, manufacture, and marketing, standards and definitions, food safety and consumer protection

547. Biological Applications of Microscopy. (2-0) Cr 2 Alt F Offered 1982 *Prereq: Permission of instructor* Stromer Principles and types of information obtained from light and electron microscopy techniques. Photomicrography and photomacrography. Demonstrations and structural data analysis with various biosystems

Courses for Graduate Students, major or minor

611. Sensory Properties of Foods. (2-2) Cr. 3. Alt. F., offered 1982. *Prereq: 411 or B B 404.* Isolation and identification of flavors, flavor evaluation, texture and consistency of foods, color descriptions of foods.

612. Food Lipids. (F N 612) (2-0) Cr. 2. Alt. S., offered 1982. *Prereq: 411 or B B 404 or F N 421.* Structure and analysis of food lipids, glyceride structure, crystal form and texture, autoxidation, refining and processing of fats and oils.

613. Food Proteins. (F N 613). (2-0) Cr 2. Alt F., offered 1981. *Prereq: 411 or B B 404 or F N 421.* Properties of proteins found in milk, eggs, meat, and cereal grains. Effect of processing on food proteins

614. Carbohydrates in Foods. (F N 614). (3-0) Cr 3. Alt. S., offered 1983. *Prereq. 411 or B B 404 or F N 421* Study of production of carbohydrates used in foods, changes they undergo during processing and storage of food, and relation of their function to their chemical and physical properties.

626. Advanced Food Microbiology. (Micro 626) (1-0 to 3-0) Cr. 1-3 Alt S., offered 1982 *Prereq. Micro 420* Topics of current interest in food microbiology, including new food-borne pathogens, rapid identification methods, effect of food properties and preservation techniques on microbial growth

660. Seminar. (1-0) Cr 1 F S SS.

690. Special Problems. Cr arr F S SS *Prereq A major or minor in food technology.*

699. Research.

Foreign Languages and Literatures

Orrin Frink, Chair of Department

Professors: Bernard, Bruner, Courteau, Dow, Frink, Graupera, Judith Lacasa, McVicker, Morris.

Emeritus Professor: Schwartz

Associate Professors: Kahn, Jaime Lacasa, Nabrotzky, Thogmartin, Vinograde, von Wittich

Assistant Professors: Chatfield, Dial, Johnson, Ruebel, Smith, Valdes, Van Iten.

Courses offered by the Department of Foreign Languages and Literatures are designed to give students a knowledge of the fundamentals of the language and of the culture and the literature of the people whose language is being studied. Foreign language study is valuable for scientific uses and for better understanding of one's own language. Furthermore, it may increase one's employment opportunities. The study of a foreign language, ranging from an introductory sequence through a minor concentration to a major emphasis, should be a part of the programs of most students.

The department offers majors in French, German, Russian, and Spanish, leading to the degree bachelor of arts, as well as instruction in Greek, Italian, Latin, and Portuguese. For a complete statement of all the college degree requirements, see *Sciences and Humanities, Curriculum.*

Students who have had foreign language training in high school in a language offered at Iowa State may obtain credit by passing appropriate examinations. Native speakers of the foreign languages may take literature and civilization courses in their languages at the 300 level or above, or may obtain credit by passing appropriate examinations at that level. Students should consult with the department to determine eligibility for test-out or taking courses

The Department of Foreign Languages and Literatures participates in the Iowa Board of Regents' foreign language summer programs in Austria, France, and Spain Information concerning these programs can be obtained directly from the department.

Language and literature courses numbered 300 and above are principally taught in the language, except that courses numbered in the 370's are taught in English translation.

Courses open for minor graduate credit: Frnch 401, 402, 441, 442, 443, 444, 480, 490, Ger 401, 402, 440, 441, 442, 443, 444, 490; F Lng 491, 492; Rus 401, 402, 441, 442, 490, Span 401, 402, 451, 452, 454, 455, 480, 490, 497

Courses Primarily for Undergraduate Students

French (Frnch)

Majors in French are required to complete a minimum of 32 credits beyond the intermediate (201, 202) level. They must complete French 242 and the following sequences: 301, 302, 321, 322, 331, 332, as well as 401 or 402, plus one from the Romance linguistics sequence 491, 492 In addition, they are required to take two 400 level literature courses.

Majors in French must pass an examination of oral and written proficiency in the language This examination should be attempted during the junior year The French staff will direct remedial work for those who do not pass the examination

101, 102. Elementary French I, II. (4-1) Cr 4 each 101 F S SS, 102 F S SS *Prereq. 102 101* Development of reading, writing, listening comprehension, and speaking in French, within the context of French culture Use of the language laboratory

104. French for Travelers. (2-1) Cr 2 S A practical course in spoken French for people who plan to travel in France or French-speaking countries. Basic grammar and expressions needed to deal with everyday situations. Practice in communicating in simple French Designed for those with little or no knowledge of French Should not be taken by those with more than two years of French Not part of the regular first year sequence; counts as elective credit only

201. Intermediate French I. (4-1) Cr 4 F *Prereq 102* Review and amplification of basic French grammar structures with emphasis on speaking, pronunciation, oral comprehension, cultural readings.

202. Intermediate French II. (4-1) Cr 4 S. *Prereq 201* Reinforcement of basic skills with emphasis on conversation and composition, literary readings. Grammar review as needed

210. Recent Francophone Literature of Africa and the Caribbean. (3-0) Cr 3 S. *Prereq: 102.* Literature of French expression in Africa and in the Caribbean the Negritude movement and its connections with the Harlem Renaissance; the Maghrebine literature of alienation paralleling the independence movements in North Africa, contemporary writings throughout the Black diaspora. Readings in French, lectures in English

242. Introduction to French Literature. (2-0) Cr 2 F S. *Prereq: 201.* A prerequisite for 300 level and above literature courses. Emphasis on reading and analysis of representative texts in the major literary genres (fiction, poetry, drama, essay). Progression toward ability to discuss literary texts in French.

301, 302. Composition and Conversation I, II. (3-0) Cr 3 each. 301: F, 302: S. *Prereq: 202.* Intensive practice in composition and conversation. Grammar review as needed. Group conversation and individual oral presentations. Compositions on diverse subjects. Conducted in French

305. Professional Level Conversation. (2-0) Cr. 2 F *Prereq: 3 years university-level French.* Activities designed to increase the oral fluency and enrich the vocabularies of the student

321, 322. French Civilization. (3-0) Cr 3 each 321 F 322 S *Prereq: 202, sequence in western civilization recommended.* Political, economic, and cultural history of France. Lectures and discussions in French
321 From the Middle Ages through the 18th century
322 From 1800 to the present day

325. Images of Contemporary France. (3-0) Cr 3 F *Prereq: 202* The institutions of contemporary France — its politics, society, arts and literature since 1945 Designed for international studies students, double majors, and non-teaching oriented students of French Discussions in French based upon the preparation of the students.

331, 332. Survey of French Literature. (3-0) Cr 3 each 331 F; 332: S. *Prereq: 202, 242.* French literature and literary criticism from its beginnings to the present
331 From early French texts to 1800 332 From 1800 to present

370. French Literature in English Translation. (3-0) Cr 3 *Prereq: Engl 201.* Study of a particular period, theme, genre, or author Specific topics to be chosen in light of student and faculty interests Readings, classroom discussions, and written work will be in English May be repeated, with permission of instructor, for a maximum of 6 credits

401, 402. Advanced Composition and Conversation (3-0) Cr 3 each. 401 F, 402: S. *Prereq. 301 or 302* Intensive practice in composition and conversation Development of an appreciation for style, idiomatic usage, and effective expression of ideas. Increased emphasis on vocabulary building, grammatical correctness and compatibility of style and content

441. Literature of the Renaissance. (3-0) Cr 3 Alt F., offered 1981 *Prereq. 242 and 301 or 302* Major writers of sixteenth century prose and poetry, including Rabelais, Montaigne, Marguerite de Navarre, the Pléiade, the *Ecole de Lyon.* Literary movements in the context of the two major historical phenoma of the century, Humanism and the Reformation

442. Literature of the Romantic and Symbolist Movements. (3-0) Cr. 3. Alt S., offered 1982 *Prereq 242 and 301 or 302* The evolution of Romanticism, its flowering and decline Origins and development of the Symbolist movement. Detailed *explications de texte* of poetic works of Hugo, de Vigny, Nerval, Baudelaire, Rimbaud, Verlaine, and Mallarmé Prose works of Chateaubriand, Balzac, Stendhal, and Flaubert

443. Classical and Baroque Literature. (3-0) Cr 3 Alt F., offered 1982 *Prereq 242 and 301 or 302* Study of works of representative authors mostly from the seventeenth century Includes the theater of Corneille, Molière and Racine, poetry and novels of Théophile, Saint-Amant, LaFontaine, Boileau, and other prose works of Cyrano, Pascal, and LaBruyère

444. Literature of the Modern Period. (3-0) Cr 3 Alt S., offered 1983 *Prereq 242 and 301 or 302* Representative authors of the twentieth century Proust, Gide, Claudel, Giraudoux, Sartre, Camus, Malraux, Mauriac. New-Theater, New-Novel, and more recent developments May also include predecessors from the late nineteenth century

480. Seminar in French Literature. (3-0) Cr 3 *Prereq 242 and 301 or 302, one 400 level literature course* Study of a selected topic in literature or literary criticism

490. Independent Study. Cr 1-6 each time taken *Prereq: Permission of department head.* Designed to meet the needs of students who seek work in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields.

German (Ger)

Majors in German are required to complete 27 credits beyond the intermediate (201, 202) level Qualification to take German 301, 302, 401, and 402 may be based on 3 years of German in high school, or study abroad, or both

101, 102. Elementary German. (4-1) Cr 4 each. 101 F.S.SS; 102: F S.SS. *Prereq. 102. 101.* Introduction to German language within the context of German culture, practice in the basic skills

201, 202. Intermediate German. (4-1) Cr 4 each Yr *Prereq. 201 102; 202 201* Review of grammar, selected readings, further practice in oral and written communication

301, 302. Composition and Conversation. (3-0) Cr 3 each 301 F, 302 S *Prereq 301 202, 302 301* Thorough study of the German language with emphasis on improving writing and speaking skills

321, 322. German Civilization. (3-0) Cr 3 each 321 F, 322 S *Prereq 202* History, geography, art, music, architecture and intellectual development from earliest times to the present

372 German Literature in English Translation. (3-0) Cr 3 S Introduction to German literature and civilization through readings, lectures, and discussions in English of selected German authors

401, 402. Advanced Composition and Conversation. (3-0) Cr 3 each 401 F, 402 S *Prereq 401 302, 402 401* Study of syntax, modes of expression Intensive practice in composition and conversation based on selected readings

440 Topics in German Literature. (3-0) Credit 3 F *Prereq 302 or 322* Studies in periods, genres, or individual authors. May be repeated for different offerings to a maximum of 6 credits

441 Enlightenment — Storm and Stress (3-0) Cr 3 Alt F offered 1982 *Prereq 302 or 322* Readings in German literature of the Enlightenment and Storm and Stress periods

442 Classicism-Romanticism. (3-0) Cr 3 Alt F, offered 1983 *Prereq 302 or 322* Readings in German literature of the Classical and Romantic periods (to 1830)

443. Nineteenth Century German Literature. (3-0) Cr 3 Alt F offered 1981 *Prereq 302 or 322* Readings in German literature from 1830 to 1914

444 Twentieth Century German Literature (3-0) Cr 3 Alt S offered 1982 *Prereq 302 or 322* Readings in German literature from 1914 to the present

490 Independent Study. Cr 1-6 each time taken *Prereq Permission of department head* Designed to meet the needs of students who seek work in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields

Classical Greek (C Grk)

101, 102 Elementary Greek. (4-1) Cr 4 each Alt Yr, offered 1981-82 *Prereq 102 101* Grammar and vocabulary of ancient Attic Greek, within the context of Greek culture, reading knowledge through texts adapted from classical authors

201, 202 Intermediate Greek. (4-1) Cr 4 each, Alt Yr, offered 1982-1983 *Prereq 201 102, 202 201* Comprehensive review of grammatical principles, emphasis on reading unadapted classical or Hellenistic texts

490 Independent Study Cr 1-6 each time taken *Prereq Permission of department head* Designed to meet the needs of students who seek work in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields

Italian (Ital)

101, 102. Elementary Italian. (4-1) Cr 4 each Yr *Prereq 102 101* Introduction to basic grammar and structure of the language, use of the language laboratory supplemented by graded readings within the context of Italian culture Especially recommended as a second area of language study for majors in French and Spanish

201, 202 Intermediate Italian. (4-1) Cr 4 each Alt Yr, offered 1981-1982 *Prereq 201 102, 202 201* Review of first-year principles and expanded study of grammar, development of written and spoken skills, introduction to Italian civilization and literature through extracts from noted authors

490 Independent Study Cr 1-6 each time taken *Prereq Permission of department head* Designed to meet the needs of students who seek work in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields

Latin (Latin)

101, 102. Elementary Latin. (4-1) Cr 4 each Yr *Prereq 102 101* Grammar and vocabulary of classical Latin, within the context of Roman culture, reading knowledge through texts adapted from classical authors.

201 Intermediate Latin. (4-1) Cr 4 F *Prereq 102* Review of grammatical principles, emphasis on reading unadapted texts from the Late Republic or Early Empire

242. Introduction to Latin Literature. (4-0) Cr 4 S *Prereq 201* Masterworks of Latin prose or poetry with emphasis on techniques of literary and historical criticism

341, 342 Advanced Readings in Latin. (3-0) Cr 3 each 341 F, 342 S *Prereq 242* Study of individual authors or genres, intensive readings in the original supplemented by modern criticism and analysis in English Authors and genres will vary, courses may be repeated to a maximum of 6 credits each

490. Independent Study. Cr 1-6 each time taken *Prereq Permission of department head* Designed to meet the needs of students who seek work in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields

Portuguese (Port)

101, 102 Elementary Portuguese. (4-1) Cr 4 each Alt Yr, offered 1981-1982 *Prereq 102 101* Introduction through the conversational approach within the context of Luso-Brazilian culture

321, 322. Luso-Brazilian Civilization and Culture (4-0) Cr 4 each Alt Yr, offered 1982-83 *Prereq 321 102, 322 321* An introduction to Luso-Brazilian civilization and culture through consideration of significant literary historical, and artistic achievements

490 Independent Study Cr 1-6 each time taken *Prereq Permission of department head* Designed to meet the needs of students who seek work in areas other than those in which courses are offered or who desire to integrate a study of literature or language with special problems in major fields

Russian (Rus)

Majors in Russian are required to complete 24 credits beyond the intermediate (201, 202) level, including 301, 302, 321, 322, 401, 402, 441, 442

101, 102. Elementary Russian (4-1) Cr 4 each 101 F, 102 S Introduction to the Russian language practice in the basic skills within the context of Russian culture

201, 202 Intermediate Russian (4-1) Cr 4 each 201 F, 202 S *Prereq 201 102 202 201* Completion of elementary grammar selected readings further practice in oral and written skills

301, 302 Composition and Conversation (3-0) Cr 3 each 301 F, 302 S *Prereq 301 202, 302 301* Review of grammar Continued work on reading writing, understanding, and speaking the language

321, 322 Russian Civilization. (3-0) Cr 3 each Alt Yr offered 1982-83 321 F 322 S *Prereq 321 202 322 321* Topics selected from the history, art, architecture, music, and geography of Russia

401, 402. Advanced Composition and Conversation (3-0) Cr 3 each Alt Yr, offered 1981-1982 401 F, 402 S *Prereq 401 302, 402 401* Writing, speaking, analysis of grammar

441, 442. Literary Masterpieces of the Nineteenth and Twentieth Centuries. (3-0) Cr 3 each Alt Yr, offered 1981-82 *Prereq 301 or 302* Readings, discussions, and compositions based on the works of Pushkin Lermontov, Gogol, Turgenev, Tolstoy, Dostoevsky Chekhov, Gorky, Pasternak, Solzhenitsyn

490. Independent Study Cr 1-6 each time taken *Prereq Permission of department head* Designed to meet the needs of students who seek work in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields

Spanish (Span)

Majors in Spanish are required to complete a minimum of 30 credits in courses numbered 300 and above These courses must include 301, 302, 321, 322, 401, 402, and 12 credits in 400-level literature courses

101, 102 Elementary Spanish. (4-1) Cr 4 each 101 F S SS, 102 F S SS Essentials of construction and vocabularly with an aural-oral approach and use of the language laboratory, within the context of Hispanic culture

201, 202. Intermediate Spanish. (4-1) Cr 4 each 201 F, 202 S *Prereq 201 102, 202 201* Review of the basic elements of the language Further intensive practice in oral communication Directed practice in writing Development of fluency with idiomatic expressions Reading of short stories

301, 302 Spanish Composition and Conversation. (3-0) Cr 3 each 301 F, 302 S *Prereq 301, 202, 302 301* Development of listening, speaking, and writing ability 301 Special emphasis on phonetics and listening skills 302 Special emphasis on composition and syntax

321, 322. Survey of Culture and Literature of the Hispanic World. (3-0) Cr 3 each 321 F, 322 S *Prereq 202* A survey of the art and architecture, the social and political structure, and the literary highlights of the Hispanic world, from the earliest times to the present

401, 402 Advanced Composition and Conversation. (3-0) Cr 3 each, 401 F, 402 S *Prereq 401 302, 402 401* Intensive practice in composition and conversation Development of idiomatic usage and effective expression of ideas Increased emphasis on vocabulary building, grammatical correctness, and compatibility of style and content

451 Spanish Literature of the Renaissance and the Golden Age. (3-0) Cr 3 *Prereq 322* Alt F, offered 1981 Discussion and analysis of representative works of Renaissance and Golden Age prose, drama, and poetry

452. Spanish Literature from the Early 19th Century into the 20th Century (3-0) Cr 3 *Prereq 322* Alt S, offered 1983 Discussion and analysis of representative works, authors, and literary trends from Romanticism to Naturalism or from the Generation '98 to the present.

454. Trends and Major Figures in Literature of Spanish America from Colonial Times to Independence. (3-0) Cr 3 *Prereq 322* Alt S, offered 1982 Study and analysis of representative works, literary schools, and movements of this period

455 Trends and Major Figures in Literature of Spanish America from Post-Independence to the Present. (3-0) Cr 3 Alt F, offered 1982 *Prereq 322* Critical and analytical study of the foremost Spanish American narrative poetry, and drama

480 Seminar in Hispanic Literature. (3-0) Cr 3 S *Prereq 322* Study of a selected topic in Hispanic literature or literary criticism

497 Spanish Syntax (3-0) Cr 3 F *Prereq Permission of instructor* Structure of sentences, based on the Spanish Academy s system of grammatical analysis Emphasis on problems faced by the English-speaking student

490 Independent Study Cr 1-6 each time taken *Prereq Permission of department head* Designed to meet the needs of students who seek work in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields

Special Courses in Foreign Languages (F Lng)

476 Methods of Teaching Foreign Languages. (Sec Ed 476) (6-0) Cr 3 F First 8 weeks *Prereq 16 credits in a foreign language* Current educational methods and their applications to the classroom Special emphasis on planning objectives, and teaching techniques Actual practice in some of the techniques

491 Linguistics for Foreign Language Teaching. (3-0) Cr 3 F *Prereq Reading knowledge of Latin or a modern Romance language* Phonetics, phonology, and morphology of French and Spanish Theories of syntax and semantics History and analysis of language teaching methods Psychology of the foreign language learner Selection and preparation of materials.

492. History of the Romance Languages. (3-0) Cr 3 Alt S, offered 1982 *Prereq Reading knowledge of Latin or a modern Romance language* From pre-classical Latin to the modern Romance languages, emphasizing both internal history (changes in sounds and forms) and external history (the social, political, and geographic context in which the language is spoken) Methods of historical linguistics Readings in earliest texts

Forestry

George W. Thomson, Chair of Department

Professors: Countryman, Hinz, Hopkins, Manwiller, McNabb, Prestemon, Scholtes, Thomson

Emeritus Professors: Bensend, Kellogg

Associate Professors: Hall, Schultz, Wray

Assistant Professors: Colletti, Jungst, Kuo, Mize

Undergraduate Study

The department offers work for the degree Bachelor of Science with a major in forestry and options in forest resource management, forest products, and forest recreation Minor and elective courses can be chosen to emphasize administration and management, quantitative-analytical techniques or biological-physical relationships as they apply to the management of forest resources, forest recreation resources, or wood products production and marketing

Many private firms as well as federal, regional, state, and local agencies seek forestry graduates to fill positions in management of natural resources for recreation, timber, water, and wildlife. The wood processing industries (such as pulp and paper, plywood, particle board, lumber, and others) offer professional opportunities in production, product development, quality control, and marekting

With appropriate graduate study, the range of opportunities is expanded to include research and education as well as more specialized administrative positions

A 6-week summer field studies program is prerequisite to admission to junior year forestry courses for students enrolled in forestry Most students should complete this requirement between their freshman and sophomore years, transfer students should check with the department for counsel on timing their completion of the field studies program

The department participates in interdisciplinary programs in Pest Management and International Studies (see *Index*). By proper selection of electives and minor courses, forestry students can obtain a second major in these programs or in other disciplines

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with a major in forestry and minor work to students taking major work in other departments. Areas of specialization for the M.S. degree are: forest administration and management, forest biology, forest biometry, forest economics and marketing, and wood science. Areas of specialization for the Ph.D are. forest biology-wood science, forest biometry, and forest economics. This graduate program is open to and suitable for students who have majored in forestry or related natural resource fields. A nonthesis master's option is available All students are required to teach and conduct research as part of their training for the Ph.D degree.

The department also participates in the interdepartmental program of Water Resources (See *Index*.)

Open to graduate students for minor credit only: 301, 302, 342, 344, 380, 380L, 390, 407, 414, 445, 451, 453, 454, 470, 481, 486, 491.

Courses Primarily for Undergraduate Students

101. Introduction to Forestry. (2-0) Cr 2. F. Historical development of forestry in the United States. Current science and practice of forestry Forests as producers of goods and services that meet human needs. Forest resource conflicts, issues, and policy.

101L. Introductory Laboratory in Forestry Practice. (0-2) Cr. 1 S Laboratory and field exposure to concepts and techniques for managing forests and other natural resources for multiple uses. Term paper required Primarily designed for forestry majors.

110. Orientation In Forestry. (1-0) Cr 0.5 F Orientation to the academic process as preparation for professional careers in forestry Career opportunities

201. Forest Biology. Cr 2 Summer Field Studies Introduction to tree biology and concepts of forest communities. Identification of regionally important trees Field studies of forest ecosystems in relation to the production of goods and services Fee

202. Wood Utilization. Cr 2 Summer Field Studies. Timber products industries of an important forest area, techniques and problems encountered in harvesting and processing wood products; field study of efficient use of timber Fee

203. Forest Resource Measurements. Cr. 2 Summer Field Studies. Field surveying and inventory sampling. Practice in measuring forest land and products including timber, wildlife, forage, and recreation Data collection, analysis and estimation Map and report preparation Fee

204. Multiple Use Operations. Cr 1 Summer Field Studies. Field study of forest resource problems and management programs Interaction of user groups, forest industries, special interest groups, resource agencies, and local communities Examination of conflicts, issues, and alternative solutions. Fee

241. Forest Resource Measurements. (2-3) Cr 3 S *Prereq Com S 175, Stat 104*. Principles underlying forest resource measurement tools and techniques Application of sampling methods appropriate for inventorying forest resources Sampling methods include stratified sampling, point sampling, and 3P sampling

256. Dendrology. (Bot 256) See *Botany*

300. Forest Resource Management. (3-0) Cr 3 S Current status of the forest resource in the United States Technical overview of mensurational, silvicultural, and managerial methods of concern to the specialist in forest-related activities. Emphasis on non-industrial private forest land Not open to forest resource management students

301. Silvics. (3-3) Cr 4 F *Prereq. 201, Bot 207* Effects of genetic, physiological, and environmental factors on processes underlying forest tree and stand growth

302. Silviculture. (3-3) Cr 4 *Prereq: 301* Manipulation of forest vegetation based on ecological principles for the production of timber and other goods and services.

342. Dynamics of Forest Stands. (2-3) Cr 3 S. *Prereq. 241* Examination of factors affecting individual tree and forest growth. Estimation of growth and yield of even-aged and all-aged stands.

344. Forest Resource Surveys. (2-2) Cr 3 F *Prereq: Stat 104, a course in natural resources.* Measurement and inventory techniques applicable to various forest resources such as fisheries, range, recreation, water, and wildlife.

357. Forest Soils. (Agron 357) See *Agronomy*

360. Forest Recreation Resource Management. (3-0) Cr 3. S. Planning and management of natural resource recreation in the context of the carrying capacity concept. Techniques to control human behavior and to protect the natural environment.

360L. Forest Recreation Field Studies. (0-3) Cr 1 S. *Prereq: Classification in 360.* Field application of environmental management techniques. Visits to recreation sites to observe management programs and problems. Reports required. Open to forestry majors only 360L is not a necessary corequisite with 360.

365. Environmental Interpretation. (3-3) Cr. 2. S, second 8 weeks. Principles of effective environmental interpretation. Audience analysis; setting of interpretive objectives, selection of appropriate media. Observation, development, and evaluation of interpretive walks, talks, leaflets, and displays

380. Basic Properties and Proper Use of Wood. (3-0) Cr 3. F *Prereq: Biol 110.* Consideration of important basic, solid wood properties and how such properties relate to proper use; an overview of solid, glued, and fiber products, wood use trends and raw material base for forest products.

380L. Wood Anatomy and Identification. (0-3) Cr 1 F *Prereq: Classification in 380.* Minute structure of wood, comparative anatomical characteristics and hand lens identification of commercially important native woods

382. Environmental Sociology. (Soc 382) See *Sociology*.

383. Sociology of Leisure and Recreation. (Soc 383) See *Sociology*.

390. Forest Fire Protection and Management. (3-0) Cr 3. F *Prereq: 201* Characteristics and role of fire in forest ecosystems. Major topics covered include fuels, fire weather, fire behavior, fire danger rating systems, fire control, and prescribed burning

397. Forest Regulation and Operations. (3-0) Cr 3 F *Prereq 241* Principles of organizing, regulating, and administering forest lands in conjunction with commercial harvest and multiple-use goals for both public and private ownership

407. Forest Influences. (2-2) Cr 3 F *Prereq 301, a course in soils* Forest-water relationships yield, regimen, quality Use of trees as environmental modifiers: micro-climate, noise abatement, wildlife habitat, water, and soil reclamation

***414. General Photogrammetry and Photo-Interpretation.** (C.E. 414) (2-3) Cr 2 F *Prereq 3 professional courses in student's major.* Use of aerial and terrestrial photographs in resource management and research. Techniques of measurement, cartographic methods, and interpretation applicable to controlled photographs. Terminates at end of 11 weeks

416. Forest Pest Management. (PP SW 416) See *Plant Pathology Seed and Weed Sciences*

***445. Natural Resource Photogrammetry and Photo-Interpretation.** (2-3) Cr 3 F. *Prereq C E 215A* Use of aerial photos and remotely sensed imagery in resource management with emphasis on multiple-use forestry Training in techniques of photo measurement, interpretation, and mapping plus procedures for forest inventory Principles of remote sensing

451. Forest Resource Economics and Quantitative Methods. (3-2) Cr 4 S *Prereq 241, Econ 201, Math 151* Application of economic principles to forest resource management. Methods of identifying and specifying problems in the management and use of forest resources. Application of mathematical and statistical models to the solution of managerial problems

453. Forest Resource Policy. (2-0) Cr 2 F *Prereq 451* Contemporary forest resource policies and issues Processes involved in the formulation of public and private policy Legal opportunities and restraints Conflict resolution. Historical development of forest resource policy.

454. Forest Resource Case Studies. (1-4) Cr 3. S *Prereq: 20 credits in forestry courses at 300 level or above.* Integrated case studies of forest resources management to illustrate methods of synthesizing the economic, mathematical, biological, political, and administrative principles discussed in preceding courses Field trips and discussion sessions arranged

470. Resource Allocation in Outdoor Recreation. (2-0) Cr 2 F *Prereq 360, Econ 201.* Analysis of factors affecting recreational use of forest resources. Current recreational issues and problems.

481. Chemical Conversion of Wood and Fiber Products. (2-3) Cr 3. Alt. S , offered 1983. *Prereq: 380, 380L.* Wood chemistry; pulp and paper; fiber products.

485. Wood Gluing and Fabrication. (2-3) Cr 3 Alt F , offered 1981 *Prereq: 380, 380L.* The use of adhesives to produce plywood, glued laminated members and particleboard; use of wood residues; combining wood with other materials; lumber grading; fabrication techniques for structures.

486. Wood Liquid Relations. (2-3) Cr 3. Alt. S., offered 1982 *Prereq: 380, 380L.* Movement of liquids and gases in wood; seasoning techniques; preservation methods; dimensional stabilization.

487. Physical Properties and Mechanical Conversion of Wood. (3-3) Cr. 4. Alt. F., offered 1982. *Prereq: 380, 380L.* Timber mechanics; thermal and acoustical properties of wood; wood machining: sawing,

veneering, chipping, flaking, planing, sanding, turning, shaping, boring

490. **Independent Study.** Cr 1 to 4 each time elected *Prereq. Junior classification, permission of instructor*
A Forest Biology
B Forest Biometry
C Forest and Recreation Economics
D Forest Management
E Wood Science
F Range Management
G Forest Photogrammetry
H Honors Program
I Forest Recreation Resource Management

491 **Forest Range Management.** (4-0) Cr 2 S, first 8 weeks *Prereq 3 courses in biological sciences* The place of the range resource in multiple-use land management Impact of past practices on the range, present management problems and policies as they concern public and private land managers Technical questions of computing carrying capacity and balancing competing uses

*Credit for both 414 and 445 may not be applied toward graduation.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

500. **Seminar.** (1-0) Cr 1 each time taken S *Prereq. Permission of instructor* Reports of research and current literature

501 **Forest Tree Improvement and Genetics.** (2-2) Cr 3 Alt F, offered 1981 *Prereq. Gen 320, Agron 421* Genetic principles as they apply to selection and breeding of forest trees Variation and genetic systems in trees, selection techniques, polyploidy, floral biology, cloning, hybridization techniques and operational tree improvement programs

504. **Advanced Forest Biology and Silviculture.** (4-0) Cr 4 Alt F, offered 1982 *Prereq. 301.* Detailed analysis of factors and processes underlying forest and stand growth and development Applications of this knowledge to forest culture Experimentation in forest biology

543. **Forest Biometry.** (3-0) Cr 3 Alt F, offered 1982 *Prereq Stat 401, permission of instructor.* Estimation of current stand volume and growth Selection of variables for volume and yield tables Application of sampling methods to forest resource surveys.

544. **Advanced Forest Pest Management.** (PP SW 544, Ent 544) See *Plant Pathology, Weed and Seed Sciences*

570 **Resource Allocation in Forestry.** (2-2) Cr 3. Alt. F., offered 1981 *Prereq. 451* Analytical approach to economic aspects of forest resource management problems Current problems in the allocation of resources in forestry Implications of current research for the analyst and manager

587 **Advanced Topics in Wood Science.** (2-0) Cr 2 Alt F., offered 1982 *Prereq. 380* Recent contributions of research and technology to product development Areas of emphasis in basic and applied research.

590. **Special Topics.** Cr 2 to 4 each time elected *Prereq 15 credits of acceptable graduate work, permission of the instructor.*
A Forest Biology
B Forest Biometry
C Forest and Recreation Economics
D Forest Management
E Wood Science
F Range Management
G Forest Photogrammetry
I Forest Recreation Resource Management

594. **Advanced Forest Resource Management.** (3-0) Cr 3 F *Prereq. 454.* A seminar approach to the critical analysis of forest management problems as exemplified in public agencies and private firms.

599. **Research.** Cr 1 to 8
A Forest Biology
B Forest Biometry
C Forest and Recreation Economics
D Forest Management and Administration
E Wood Science

Courses for Graduate Students, major or minor

601 **Research Methods.** (3-0) Cr 3 F *Prereq Permission of instructor* Forestry graduate student orientation, departmental research philosophy and program, student and faculty research presentations. Scientific method, hypothesis formulation and testing, project and study planning, preparation and critical analysis of study plans Communication of research results Institutional factors in research

602. **Forest Biology Seminar.** (1-0) Cr 1 F *Prereq. Permission of instructor* Presentation of papers and discussions of topics on selected areas in advanced forest biology May be taken up to three times for credit

645. **Advanced Forest Biometry** (2-0) Cr 2 Alt S., offered 1982 *Prereq 543, Stat 402, permission of instructor* The theory and application of statistical and mathematical methods to forest measurement Quantification problems in stand structure and growth Recent developments in forest biometry

688. **Formation of Wood.** (2-0) Cr 2 Alt S., offered 1982 *Prereq 380* Structure of cell wall in woody plants Measures of wood quality, environment as related to quality Structure as related to the physical properties of wood

699. **Research.** Cr 1 to 8
A Forest Biology — Wood Science
B Forest Biometry
C Forest Economics

Freshman Engineering

Arvid R Eide, Chair of Department

Professors: DeJong, Eide, Mashaw, Northup, Sanders

Emeritus Professor: Almfeldt

Associate Professors: Ambal, Crawford, Dowling, Jenison, Mercier, Vogel

Assistant Professors: Benner, Bolluyt, Genalo, Iasevoli, Jacobson, Knight, Legg, Russell, Sayre, Woolson

Undergraduate Study

The Department of Freshman Engineering has responsibility for the integration and coordination of areas associated with the basic freshman program (See *College of Engineering)* such as graphical communication, design, engineering computation, advising, career orientation, and academic assistance Students entering the College of Engineering with an undeclared major are assigned to the Department of Freshman Engineering The department offers orientation programs structured to provide information concerning all disciplines for undeclared students.

The primary objective of the course offerings is to provide a basic program for all engineers that will prepare the student to progress into any curriculum in the College of Engineering.

The areas of academic study for engineering students are design graphics and computation Design graphics is an integration of engineering graphics with principles of design Primary emphasis is placed on graphics with the design process integrated throughout the course The use of graphical procedures balanced with design concepts develops an individual's ability to visualize and comprehend the configuration of systems and parts, and to effectively communicate ideas and technical information. The design process will not only help prepare the student for later courses in engineering design but also will develop a thought process that is applicable to any problem-solving situation The computations course provides the student a background of skills and techniques for orderly and efficient solutions of engineering problems

In addition to the above services, the broad range of technical experience within the department faculty makes it possible to offer a variety of courses in support of other curricula.

Courses Primarily for Undergraduate Students

101 **Orientation.** (1-0) Cr R F S. An orientation to the engineering college Investigation of professional fields and considerations in selecting an engineering career

125. **Graphic Communications.** (2-4) Cr 3. F.S.SS. Introduction to various forms of graphic communication used by designers Develop proficiency in. basic drafting skills including layout, line quality, use of equipment, and lettering, the use of single and multiview drawings including sectioning and dimensioning, and pictorial drawing systems with emphasis on perspective. Presentation drawings using shades, shadows, and reflections

145. **Architectural Graphics I.** (2-4) Cr 3. F.S.SS. Architectural graphics fundamentals with emphasis on excellence and accuracy, lettering and use of instruments. Orthographic projection theory, including use of auxiliary planes, revolution, geometry of points, lines, planes, and solids. Determination of intersections, angles and clearances involving lines, planes, and solids with applicetions. Pictorial drawings in isometric and oblique Roof plane intersections. Topography, land measurement and site planning. Plans, sections, elevations, and associated conventions for design presentations

146. **Architectural Graphics II.** (2-4) Cr 3. F S.SS *Prereq 145* Theory and application of perspective projection including office and perspective plan methods. Alternate methods of construction and enlarging perspectives Application of shades and shadows and design drawing conventions to plans, sections, elevations, and perspectives for presentation.

155. **Engineering Problems.** (2-0) Cr. 2. F S.SS. *Prereq. Credit or classification in Math 165 or 175.* Analysis, solution, and presentation of engineering problems Approximations, accuracy and significance, and correct use of S I units Use of computational equipment Flow diagrams. Selected engineering concepts.

155L. **Engineering Problems Laboratory.** (0-2) Cr 1 F S SS *Prereq Classification in 155.* Solution of engineering problems using a large scale computer Programming, programming language, use of computer terminals Must be accompanied by 155

165. **Engineering Graphics and Conceptual Design.** (2-4) Cr 3 F S.SS. Engineering graphics integrated with conceptual design Drawing systems including orthographic projection with applications to basic three-dimensional geometry and engineering drawings, axonometric and oblique pictorial Freehand and instrument techniques A study of the design process and its application to an open-end project including a formal engineering report

190. **Special Problems.** Cr 1 to 5 each time taken Experimental courses or honors seminars pertaining to topics common to more than one engineering curriculum

290. **Advanced Graphical Problems.** Cr. 1 to 5. S. *Prereq: Permission of department chairman.* Advanced graphical theory and application tailored to any subject area approved by the department adviser. Some example topics are· design layout drawing, true position dimensioning and geometric tolerancing, advanced detailing, map and contour drawing, production illustration, analysis of empirical data, graphical calculus, nomography Other topics investigated on request.

General Graduate Studies

(Interdepartmental Program)

Martin Ulmer, Chair, Supervisory Committee

Supervisory Committee: J. W Elrod (Arts and Humanities), P. A. Hartman (Biological Sciences), F. C. Peterson (Physical Sciences), M. G. Miller (Social Sciences); L. W. Glass

The degree Master of Science or Master of Arts with major in general graduate studies is available to graduate students who wish to have a more diversified program of advanced tudy than that generally permitted students who specialize in a single subject. The General Graduate Studies program is considered a terminal master's degree; those wishing to pursue the doctorate should enter departmental programs. Those who elect general graduate studies are allowed to take courses in three different approved graduate areas, each subject contributing a minimum of 10 credits toward the 35 graduate credits required for the degree. Each of the three areas chosen must be specifically authorized for major or minor graduate study in the department statement. Courses which may be used for credit toward this degree are selected from those listed in the Graduate College catalog for graduate credit.

Both thesis and nonthesis options are available If a thesis is chosen, a maximum of 5 credits in Research 699 may be counted in the total of 35 required credits. If the nonthesis option is elected, evidence of original creative effort must be presented. This may be in the form of a demonstration of independent creativity such as a written report of laboratory, field, or library research, a project in fine arts, or some other original contribution acceptable to the student's supervisory committee In the nonthesis option a maximum of 5 credits in 500-level special topics may be counted toward the total of 35 graduate credits

A graduate advisory committee, in consultation with the student, will decide on the choice of option. The committee also aids the student in planning a program of study and in selecting appropriate courses.

Foreign language requirements, if any, will be decided by the student's committee

Although the program is open to any qualified graduate student, it is most useful to those who wish to improve their subject matter competence for teaching, either in high school, college, or university.

Programs in biology, physical sciences, social sciences, humanities, art, or other disciplines can be especially designed for students or teachers who wish to increase their knowledge in several specialized areas

Students who wish to participate in general graduate studies should communicate with the chairman in charge of the program, or with the chairman of one of the subcommittees.

Genetics

Alan G. Atherly, Chair of Department

Professors: Atherly, Imsande, Miller, Palmer, Peterson, Pollak, Robertson, Sadanaga, Welshons

Professor Emeritus: Hollander

Associate Professor: Stadler

Assistant Professor: McDonald

Undergraduate Study

The Department of Genetics offers instruction in the science of heredity, and in the operation of the laws of inheritance in animals, plants, microorganisms, and human populations The courses are also intended to demonstrate the broad cultural and philosophical aspects of this biological science

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with major in genetics, and minor work to students taking majors in other departments

Prerequisite to major work is the completion of a thorough undergraduate curriculum in a biological science, or in a physical science, or in agriculture with evidence of excellent scholarship and aptitude for scientific research

The department offers the student the opportunity to work in such areas as *Drosophila*, maize, soybean, population, statistical, immunological, microbial, biochemical, developmental, and mammalian cell genetics Minor work may be taken in agronomy, animal science, bacteriology, biochemistry, botany, horticulture, mathematics, statistics, veterinary medicine, and zoology.

The department also participates in the interdepartmental programs of Molecular, Cellular, and Development Biology; and Immunobiology (See *Index*)

Open to graduate students for minor credit only 460.

Courses Primarily for Undergraduate Students

***260. Human Heredity and Society.** (3-0) Cr 3. F *Prereq: Biol 109 or Anthro 219.* A survey course in genetics for non-biology majors interested in heredity and its importance, and implications to self and society Not recommended for those intending to take advanced courses in genetics. Evolution, the informational machinery of the cell, laws of inheritance, population genetics, human inheritance, social, ethical, and political issues in genetics

***320. Introductory Genetics: A Classical Approach.** (3-0) Cr 3 F S SS *Prereq: Biol 109 or 110* A classical approach to Mendelian inheritance, linkage and crossing over, chromosomal aberrations, variations in chromosome number, gene structure, function and regulation, sex determination, extra nuclear inheritance and population genetics.

***330. Principles of Genetics: A Molecular Approach.** (3-0) Cr. 3. F.S. *Prereq: Biol 109 or 110; Chem 231 or 332* Recommended for science majors. Modern molecular aspects of Mendelian inheritance; DNA structure, replication, mutation and repair; regulation of gene expression; genetic mapping; recombination, extranuclear inheritance and population genetics.

460. Introduction to Mathematical Genetics. (2-0) Cr. 2. *Prereq: Knowledge of elementary algebra and 320 or 330.* Pollak. Elementary probability and its application to Mendelian population, and quantitative genetics.

490. Independent study. Cr arr *Prereq 320 or 330*

*Credit for graduation will not be allowed for more than one introductory course in genetics (260, 320, 330) See *Sciences and Humanities, Curriculum.*

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

501. Hereditary Mechanisms. (2-0) Cr 2 F *Prereq Undergraduate course in biology and genetics* Topics Recombinational analysis in procaryotes and eukaryotes, variation in chromosome structure, aneuploidy and euploidy in plants and animals, gene structure and function, and mechanisms of sex determination Designed primarily for graduate students in an agricultural discipline

534. Molecular Development and Differentation. (Zool 534) See *Zoology*

535. Laboratory in Cytogenetics. (0-6) Cr 2 Alt S , offered 1983 *Prereq: 501 and Bot 444* Palmer Laboratory methods and techniques for cytogenetical research, with emphasis on plants.

536, 537. Genetic Statistics. (Stat 536, 537) See *Statistics.*

550. Population Genetics. (An S 550) See *Animal Science*

560. Evolutionary Genetics. (2-0) Cr 2. Alt F offered 1983. *Prereq. 330 or 320.* McDonald Genetic basis of evolutionary process in higher organisms with emphasis on molecular evolution Topics covered include: alternative strategies of molecular adaptation, origin and evolution of the genome, regulatory vs structural gene evolution, gene duplication and rearrangement in evolution

590. Special Topics. (0-3 to 9) Cr Arr *Prereq 330 or 320.*

599. Research.

Courses for Graduate Students, major or minor

610. Genetics of Bacteria and Bacteria Vacteriophage (Bact 610) See *Microbiology*

615. Molecular Immunology. (B B 615) See *Biochemistry and Biophysics*

619. Developmental Genetics. (2-0) Cr 2 Alt F , offered 1982 *Prereq 330 and B B 405* Aspects of cellular development governed by genetic mechanisms Topics covered include genetic redundancy, interaction of nuclear and cytoplasmic genomes, developmental processes in animals and plants, cell fusion, and genetic manipulation in plants

620. Molecular Genetics. (Micro 620 B B 620) (2-0) Cr 2 Alt S , offered 1982 *Prereq 330 or 320, B B 405* Atherly B B 620 Detailed analysis of procaryotic and some eucaryotic genetic material at the molecular level including replication, transcription, repair, recombination, control of gene expression (bacteral and viral), and genetic engineering using restriction endonucleases

621. Somatic Cell Genetics. (B B 621) (2-0) Cr. 2 Alt S., offered 1983. *Prereq: 330 or 320 and B B 405.* Stadler The use of mammalian somatic cells in modern genetic research Establishment and characterization of primary cell cultures and permanent cell lines Mutagenesis, cell fusion theory, analysis of cell hybrids, and recent advances in somatic cell genetics.

625. Cytogenetics and Advanced Plant Genetics. (3-0) Cr 3. Alt S , offered 1983. *Prereq: 501* Robertson An analysis of chromosomes and their involvement in crossing over, chromosomal aberrations, polyploidy and plant evolution Gene regulation, cytoplasmic inheritance, and genetic control of meiosis in plants

675. Nucleic Acids and Gene Regulation. (B B 675) *See Biochemistry and Biophysics*

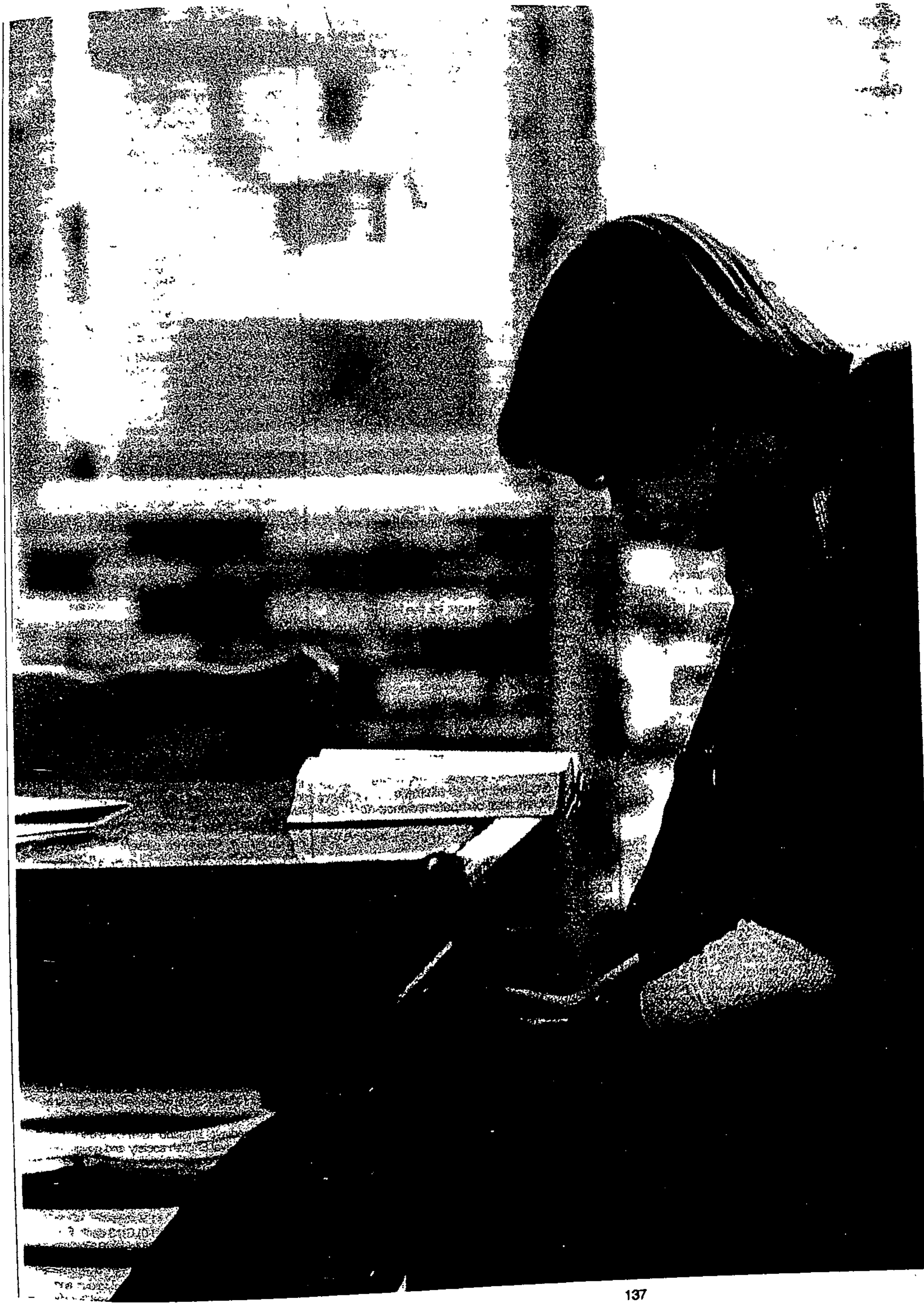
690. Seminar. Cr 1 F S

698. Seminar in Molecular, Cellular and Developmental Biology. (MCDB 698) See *Molecular, Cellular and Developmental Biology*

699. Research.

Geodesy and Photogammetry

For description of courses, see *Civil Engineering.*



Geography

For description of course, see *Earth Sciences*.

Geology

For description of courses, see *Earth Sciences*.

Gerontology

(Interdepartmental Minor)

D. C. Charles, Chair, Supervisory Committee

Supervisory Committee: P. A. Garcia, W. Hutchison

Work is offered for an interdepartmental graduate minor with the following departments participating in the program: Architecture, Biochemistry and Biophysics, Business Administration, Economics, Family Environment, Food and Nutrition, Home Economics Education, Physical Education, Political Science, Professional Studies in Education (Adult Education), Psychology, Sociology and Anthropology, Speech, and Textiles and Clothing.

A declared graduate minor in gerontology consists of a minimum of 12 credits taken from a list of acceptable courses, and from at least two departments. Nine of these 12 credits will be in courses focused specifically on aging At least one member of the gerontology forum will be on a student's advisory committee; this person must be at least an associate member of the Graduate Faculty for a master's committee and a full member for a doctoral committee Because gerontology is a rapidly developing area, departments participating in the minor and specific course offerings may change in the future. Contact the chair of the supervisory committee for information on the program and for the list of courses in the graduate minor in gerontology.

History

Richard Lowitt, Chair of Department

Professors: Apt, Cravens, Dobson, Keller, Kottman, Lowitt, Schofield

Professor Emeritus: Geiger

Associate Professors: Avraamides, Bennett, McCarthy, McJimsey, Plakans, Rawson, Whitaker, Wilson, Wilt

Assistant Professors: Madison, Marcus, Osborn, Zaring.

Instructor: Schwieder

Undergraduate Study

For the undergraduate curriculum in sciences and humanities, with major in history, see *Sciences and Humanities, Curriculum*

The department offers a variety of introductory courses (200 series) designed to serve as either general education or as introductions to certain advanced courses in history or other subject areas. Advanced undergraduate courses are offered in the history of Europe, Asia, Latin America, the United States, technology and science, and in other selected topics.

The prospective major may earn either a Bachelor of Arts or Bachelor of Science degree. Candidates for the Bachelor of Arts must complete a two-year foreign language sequence in one language. Anyone who wishes to pursue graduate study in history should acquire proficiency in at least one foreign language

The minimum required for a major in history is 30 credits, of which at least 24 must be above the 200 level. One seminar in history is required; i.e., all history major programs must include 495 or one graduate-level seminar.

The college requires no minor. Those students who prefer minors usually choose from such complementary disciplines as political science, English, sociology, psychology, economics, philosophy, or foreign languages and literatures.

Students majoring in history may also earn a second major in international studies See *International Studies*.

For detailed statements on the major in history as preparation for professional programs, see *Sciences and Humanities Cross-Disciplinary Programs* and *Preprofessional Programs*.

Graduate Study

The department offers work for the Master of Arts degree with major in history, for the Master of Arts and Doctor of Philosophy degrees with major in history of technology and science, and minor work for students majoring in other departments. For admission and degree requirements for work in history of technology and science, see separate department brochure.

For the M.A. in history, students may elect a thesis or a nonthesis program The foreign language requirement or an alternate requirement, such as computer science or statistics, is determined by the student's advisory committee

The Master of Arts in history program serves as a basis for continued study in history, law, or business; preparation for teaching in high school or junior college; preparation for government service; or as part of a general education.

The department participates in the interdepartmental program of Technology and Social Change. (See Index.)

Open to graduate credit, major† or minor: all 400-level courses.

†A history graduate student may take any 400-level course except 490 and 495 for major graduate credit; however, no more than 12 credits of 400-level courses may be used toward the minimum credits required for the degree as listed on the program of study. Additional work is required for graduate credit.

Courses Primarily for Undergraduate Students

History of Europe (Hist)

***201, 202. Introduction to Western Civilization.** (3-0) Cr. 3 each. F,S. Western civilization from ancient Mediterranean world to the present. Social and cultural developments; economic and political ideas and institutions; problems of historical change and continuity 201 To 1650 202 Since 1650

265. Introduction to Ancient Civilization. (3-0) Cr 3 S Avraamides Introduction to the history and civilization of the Ancient Near East, Greece and Rome from the beginning of settled agricultural communities to the end of the third century A.D.

***325, 326. History of England.** (3-0) Cr 3 each F S Zaring. 325: England from pre-history to 1688. Growth of political and religious institutions, medieval social, economic, and constitutional development, Tudor and Stuart monarchies; Reformation and civil war 326: England since 1688. Political and social change constitutional and economic development; Britain as a world power; modern British society

401. Ancient Near East. (3-0) Cr. 3. F Avraamides Political, socio-economic, artistic, and religious history of ancient Mesopotamia and Egypt.

***402, 403. Ancient Greece and Rome.** (3-0) Cr 3 each F S Avraamides 402 Ancient Greece from the Bronze Age to the Hellenistic Kingdoms, the evolution of the Greek polis and its cultural contributions. 403 Ancient Rome from the founding of the city of Rome to the rise and decline of the Roman Empire; its political and administrative institutions and cultural contributions

***405, 406. History of Medieval Western Europe.** (3-0) Cr. 3 each. F S. Madison Development of political, economic, and social institutions 405 Early and Central Middle Ages, 284-1050 406. High and Late Middle Ages, 1050-1500.

407. Medieval and Renaissance Italy. (3-0) Cr 3 F Madison Development of the city-republics, rise of the signori, new intellectual directions, and historiography

408. Europe, 1500-1648. (3-0) Cr 3 Alt. S. Zaring The Northern Renaissance; the Church and Luther; Protestant reform and Roman-Catholic counter-reform, social, cultural, and economic changes, Spain in triumph and decline; religious wars and the emergence of France.

410. 19th Century Europe. (3-0) Cr 3 S Apt. Europe in the age of nationalism, revolution, and imperialism

***411, 412. Contemporary Europe.** (3-0) Cr 3 each F S Wilt 411: Europe from the 1890s to the 1930s 412: Europe since the 1930s with emphasis on the origins, course, and effects of World War II.

414. European Intellectual History. (3-0) Cr 3 Alt F Apt. Modern European thought, 1600-1950

416. European Society in the Age of Enlightenment. (3-0) Cr. 3. Alt. F., offered 1982. Plakans. Europe from the mid-seventeenth century to the French Revolution, with emphasis on social structure and on the culture of the traditional social orders.

417. European Society and the Industrial Revolution. (3-0) Cr. 3 Alt. S., offered 1983. Plakans England and the continent during the period of European industrialization (1750-1900), with emphasis on the relationship between industrial and social change

419. French History. (3-0) Cr 3 Alt. F Apt Modern French history, 1600 to the present

***421, 422. History of Russia.** (3-0) Cr 3 each Yr Rawson. 421: Russia to 1825. Origins of the Russian people; Byzantine influences; Mongol invasion, rise of Moscow; advent of Westernization. 422: Russia since 1825. The role of autocracy; era of reforms; conflict between state and society; revolution; transformation of society in the Soviet period; the USSR as a world power.

424. History of Modern Germany. (3-0) Cr 3. Alt. S., offered 1982. Wilt. Cultural, economic, and political developments in nineteenth and twentieth century Germany.

426. Modern East Central Europe. (3-0) Cr. 3. Alt. S., offered 1982. Plakans. Political, social, and cultural developments in Czechoslovakia, Poland, the Baltic States, Hungary and the Balkans during the nineteenth and twentieth centuries. Rise of nationalism; creation of independent states; agrarian reform; emergence of communist governments.

***427, 428. Medieval England.** (3-0) Cr 3 each F S Madison. Medieval English society and government examined through contemporary sources in translation Legal and constitutional developments emphasized 427: Anglo-Saxon, Norman, and Angevin England, c. 342-1189. 428: Plantagenet, Lancastrian, and Yorkist England, 1189-c. 1509.

***430, 431. Modern England.** (3-0) Cr 3 each F S Zaring. 430: England from 1688 to 1830. Political, social, cultural, economic development; England as a great power. 431: England since 1830. Parliamentary and constitutional development; social reform and economic change; imperial Britain; the welfare state

History of Asia, Africa, Latin America (Hist)

207 Introduction to Chinese Civilization. (3-0) Cr. 3 F Bennett Origins, development, decline and transformation of China from earliest times to the present

208. Introduction to Japanese Civilization. (3-0) Cr 3 S Bennett Origins, development, and transformation of Japan from earliest times to the present

211 Introduction to African History. (3-0) Cr 3 F McCarthy The diversities that characterize not only African societies and individuals but also the geographical and ecological regions of Africa Major emphasis on the period from 1700 to the present accelerating European over-rule, African reactions and initiatives, subsequent decolonization, and the still incomplete re-establishment of independence

***336, 337 History of Modern China.** (3-0) Cr 3 each F S Bennett 336 China from 1644 to 1912, internal and external stimuli on the traditional structure leading to reform and revolution 337 China from 1912 to the present, the search for a new order and the continuing Chinese revolution

***340, 341 History of Latin America.** (3-0) Cr 3 each F S Osborn 340 History of colonial Latin America from European discovery and colonization to the wars for independence 341 Modern Latin America from national origins at the beginning of the nineteenth century to the present

436. Modern Japanese History. (3-0) Cr 3 Alt F Bennett Japan 1600 to the present; emphasis on the transformation of feudal Japan into a post-industrial society

441 History of Mexico. (3-0) Cr 3 S Osborn Colonial background and the history of Mexico since independence with emphasis on the significance of the Mexican Revolution for the development of contemporary Mexico

History of the United States (Hist)

***221, 222. Introduction to American History.** (3-0) Cr 3 each F S 221 Colonial foundations revolution, confederation, and constitution, nationalism and democracy, sectional disunity, Civil War, and reunion 222 Industrialization, emergence as a great power, boom and depression, war, internationalism and the Cold War, the modern industrial society

275 Black and White in America. (3-0) Cr 3 Alt F McJimsey Historical trends in race relations, 1619 to the present Slavery, segregation, and the nature of black and white protests against these institutions

***351, 352 The Social and Cultural History of the American People.** (3-0) Cr 3 each 351 F, 352 S Cravens History of the ordinary peoples of the United States since 1800, how they lived, worked, and played The development of society, popular ideas and their dissemination, conditions of life, work, and entertainment, the arts, music, architectural styles, material culture, rural and urban life-styles, sex roles, majority-minority relations, religion, mass culture, corporations, and technology in modern times 351 from 1800 to 1900 352 since 1900

***365, 366. History of American Agriculture.** (3-0) Cr 3 each 365 F 366 S Whitaker American agricultural development from colonial times to the present 365 European background, colonial period to 1865 366 1865 to the present

370 History of Iowa. (3-0) Cr 3 F,S Schwieder Survey of major social, cultural, and economic developments in Iowa from the late 1700s Emphasis on minority groups pioneer life, early economic development, industrial development, educational and religious development, and outstanding personalities

386. History of Women in America. (W S. 386) (3-0) Cr 3 F S A survey of social, economic, and political aspects of women's role from the colonial era to the present, with emphasis on employment, education, concepts of sexuality, and the changing nature of the home

450. Colonial America. (3-0) Cr 3 F Keller Exploration, colonization, and development of political, economic, social, and cultural institutions of the North American colonies before 1754

451 American Revolution. (3-0) Cr 3 S Keller Participants, ideas, and events leading to independence and the foundation of the American Republic, 1754 to 1787

452. The New Nation. (3-0) Cr 3 Alt F Development of the political institutions and the social, economic, and cultural fabric of the new nation from 1787 to 1828

454. Politics and Sectional Conflict. (3-0) Cr 3 F McJimsey Origins of second party system. Social and economic forces that sustained the system and ultimately caused its collapse and sectional division, 1815-1861

455. The Civil War and Reconstruction. (3-0) Cr 3 S McJimsey Emphasis on military and political events of the Civil War and their influence on postwar America, 1861-1877

457. The Populist-Progressive Years. (3-0) Cr 3. S Dobson The United States' transition from an agrarian society to a mature industrial giant, emphasizing political, economic, and social developments of the late 19th and early 20th centuries

***458, 459 U S Since World War I** (3-0) Cr 3 each F S Lowitt, Kottman 458 America in depression and war Major developments of the nation, 1919-1950; new economic era, Hoover and depression, New Deal, World War II, and Cold War 459 Contemporary America Major developments of the nation since 1950, Korean War, modern Republicanism, New Frontier and the Great Society, Vietnam, social disturbances, and conservative resurgence

***462, 463. American Thought and Culture Since 1607** Cr 3 each Alt F S Cravens 462 F, 463 S American cultural values and social and political thought from the seventeenth century to the present 462 The rise of the middle-class republic, 1607-1865, the role of religion, rationalism, and republicanism in the seventeenth and eighteenth centuries, Enlightenment and Revolution, the Revolution's legacy; the democratic mode in politics, religion, the economy, society, and culture, impact of Civil War and industrialization 463 American democracy in the Machine Age, 1865 to the present multimedia inquiry into social thought, moral values, and culture in the urban-industrial era, 1920-1945 as a turning point, the contemporary situation

464 Nineteenth Century American Social History Cr 3 Alt S Schwieder Rise of modern industrial society in nineteenth century America, the family, churches, and other social institutions, immigration, social and geographical mobility social, economic, and ethnic stratification

465 The Westward Movement and Frontier Development. (3-0) Cr 3 S Whitaker Occupation distribution, and political organization of the public domain, Indian-white relations, economic exploitation of the public domain (trapping, mining, lumbering, ranching, farming), and social adjustments (law and order, religion, education, and culture)

***467, 468. History of United States Foreign Policy** (3-0) Cr 3 each F S Dobson, Kottman Diplomatic history emphasizing the growth of American influence around the world and the resulting consequences and conflicts 467 Diplomacy from the American Revolution, America's rise as a world power, the First World War and post-war entanglements 468 Diplomacy from the 1930s to the present including U S -Soviet Relations, the Second World War, and the Cold War

History of Technology and Science (Hist)

The undergraduate program in history of technology and science has been restructured to offer a sequence of courses leading from basic surveys through new courses in the history of particular technologies and sciences It is recommended that students electing 480, 481, 482, 485, 486 have taken a basic survey in history of technology or science, or have taken a college-level course in an appropriate technology or science, or seek the permission of the instructor

***271, 272. Physics, History, and Society** (Phys 271 272) See *Physics*

***280, 281 Introduction to the History of Science** (M E 280, 281) (3-0) Cr 3 each 280 F, 281 S Wilson 280 Ideas of nature from Babylonia to the Renaissance 281 Science from the seventeenth-century scientific revolution to Darwin and Einstein

***284, 285. Introduction to the History of Technology and Engineering.** (M E 284, 285) (3-0) Cr 3 each 284 F, 285 S 284 Marcus Technology in various civilizations from Mesopotamia, Egypt, Greece, and Rome to medieval and Renaissance Europe 285 Technology in the Western world from the seventeenth to the twentieth century

320. Science, Technology, and the Arts. (3-0) Cr 3 Alt F, offered 1981 Schofield Examination of parallel formal and structural elements in scientific thinking, technological design, and composition in literature, painting, architecture, and music from the late medieval period to the early modern

323. Science and Religion. (Relig 323) (3-0) Cr. 3. Alt F, offered 1982 Wilson. History of the changing interplay of science and religion in man's understanding of nature, from Platonism to Darwinism.

362. Engineer in History. (3-0) Cr 3. Alt S, offered 1983 Marcus Development of the engineering profession and its place in society, with emphases on the modern period, technocracy, and technology assessment

387. Technology, Science, and Society in Modern Europe. (M E 387) (3-0) Cr 3 Alt S. Offered 1982 Wilson From the late eighteenth-century beginnings of the industrial revolution in Britain to World War I Examination of scientists' and engineers' influence on society and of society on them

480. History of Agricultural Sciences and Technology. (3-0) Cr 3 Alt S, offered 1983 Marcus Rise of mechanization and scientific agriculture since the industrial revolution, set in the social and cultural context of the western world

481 History of Chemical Sciences and Their Technologies. (3-0) Cr 3 Alt F, offered 1981 Schofield Development of theories and processes relating to the nature and transformation of matter in chemistry and associated engineering fields. Emphasis on chemistry and chemical theory since the seventeenth century and on the creation of concepts and processes for the controlled production of substances on an industrial scale since the eighteenth century

482. History of the Life Sciences and Their Applications. (3-0) Cr 3 Alt F, offered 1981 Cravens Emergence of the human sciences and technologies — medicine, physiology, cytology, public health, and social sciences — in the social and cultural context of the western world Emphasis on developments from Darwin and Pasteur to the present.

485. History of Physics and Physical Engineering. (3-0) Cr 3 Alt S, offered 1982 Wilson Interactions between the science of physics and the branches of engineering associated with it, from the post-Newtonian era to the age of Einstein

486. Problems in Nineteenth and Early Twentieth Century Physics. (3-0) Cr 3 Alt S, offered 1983. Wilson A study of two revolutions in physics the nineteenth-century creation of thermodynamics and the science of the ether and twentieth century revolution associated with Einstein and Bohr

488 History of American Technology. (3-0) Cr 3 Alt F, offered 1981 Marcus Technology in America with emphasis on the industrial revolution and its consequences American invention and its relation to science, technology as social response and perception of it as social problem, locus of support for process of technological innovation

489. History of American Science. (M E 489) (3-0) Cr 3 Alt S Offered 1982 Cravens Science and its social relationships since the mid-nineteenth century, interaction of scientific discoveries and the development of society Continuing impact of Darwinism and other scientific theories, science and social thought, modern medicine and public health, science and industry; science and agriculture; the social sciences, government and science, science and the consumer, the atomic age, big science and the environmental dilemma, the energy crisis, the role of science in a democracy

Topical Courses (Hist)

375. United States Business History. (3-0) Cr 3 F Dobson The development of business structures, institutions, and practices from the colonial joint-stock companies to the modern conglomerate, including economic, legal, regulatory, and international aspects

376. International Business History. (3-0) Cr 3. S. McCarthy Comparative approach, based on selected examples from Europe, Africa, Asia, and Latin America, to such topics as entrepreneurship, organization, and the controversial roles of business people and groups in creating both development and underdevelopment.

381. World Economic History. (3-0) Cr 3 F McCarthy Origins and evolution of European capitalism; varieties of agricultural and industrial transformation in Europe; expansion of Europe and impact on Africa, Caribbean, Latin America, and Asia

382. United States Economic History. (3-0) Cr. 3. S. McCarthy. Origins and evolution of United States capitalism; importance of varieties of economics; importance of legal structures, growing interdependence of power sectors

384. History of the Family in the Western World. (3-0) Cr 3. Alt. F., offered 1981 Plakans Changing family forms in Western Europe from medieval times to approximately 1900, with the American familial experience as applied to this period

390. Modern Military History. (3-0) Cr 3. F Wilt Relationships between war and society in the United States and Europe from 1815 to the present, special emphasis on the World War I and World War II experiences.

490. Independent Study. Cr 1 to 3 each time taken *Prereq: 9 credits in history, permission of department chair* Reading and reports on problems selected in conference with each student

495. Proseminar in History. (3-0) Cr 3 *Prereq: Open to seniors, others by permission of instructor* Literature of major historical problems that have become subjects of dispute and varied interpretations among historians. Area of coverage varies

*Any course may be taken independently

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates.

History of Europe (Hist)

512. Proseminar in European History. (3-0) Cr 3 each time taken *Prereq Permission of instructor* Readings in European History
A Ancient
B Medieval
C Modern

594. Seminar in European History. (3-0) Cr 3 each time taken *Prereq Permission of instructor* Topics vary each time offered.
A Ancient
B Medieval
C Modern

History of Asia, Latin America (Hist)

510. Proseminar in East Asian History. (3-0) Cr 3 each time taken *Prereq. Permission of instructor* Readings in East Asian History Topics vary each time offered

513. Proseminar in Latin American History. (3-0) Cr 3 each time taken *Prereq Permission of instructor* Readings in Latin American history Topics vary each time offered

592. Seminar in East Asian History. (3-0) Cr 3 S *Prereq. Permission of instructor* Topics vary each time offered.

595. Seminar in Latin American History. (3-0) Cr 3 each time taken. *Prereq. Permission of instructor* Topics vary each time offered

History of the United States (Hist)

511. Proseminar in American History. (3-0) Cr 3 each time taken. *Prereq. Permission of instructor* Readings in American history Topics vary each time offered
A. Colonial period
B Nineteenth century
C Twentieth century

593. Seminar in American History. (3-0) Cr 3 each time taken *Prereq. Permission of instructor* Topics vary each time offered
A Colonial Period
B Nineteenth Century
C Twentieth Century

Topical Courses

514. Proseminar in Comparative Economic History. (3-0) Cr. 3 each time taken. *Prereq: Permission of instructor.* Readings in comparative economic history Topics vary each time offered.

580. Museum Internship. Cr varies each time taken. *Prereq: 15 graduate credits in history; permission of instructor.*

583. Historical Methods. (3-0) Cr 3. *Prereq: Permission of instructor.* Original sources, bibliography, criticism of evidence, form, statistical analysis.
A Written evidence and analysis
B Statistical evidence and analysis

585. Teaching Methods. Cr 1 to 3 each time taken *Prereq. Permission of instructor.* Topics vary each time offered
A. Teaching Methods
B Curriculum Development in History
C Implementing Teaching Techniques

590. Special Topics. Cr 1 to 3 each time taken *Prereq Permission of instructor*

597. Seminar in Comparative Economic History. (3-0) Cr 3 each time taken *Prereq: Permission of instructor* Topics vary each time offered

598. Introduction to Archives and Special Collections. (3-0) Cr 2 each time taken *Prereq Graduate classification*

History of Technology and Science (Hist)

The graduate program in history of technology and science has been restructured with a new sequence of courses leading to the M A. and Ph D degrees

570, 571. Seminar in General History of Science I, II. (3-0) Cr 3 each Yr Wilson The history of science from pre-classical civilizations to the Age of Galileo, and from Galileo to modern times, with emphasis on the historical literature, varying interpretations of the period, and problems for continuing research

574, 575. Seminar in General History of Technology I, II. (3-0) Cr 3 each Yr. Marcus. The history of technology from pre-classical civilizations to the eve of the Industrial Revolution, and from the Industrial Revolution to modern times, with emphasis on the historical literature, varying interpretations of the period, and problems for continuing research

576, 577. Proseminar in Historiography of Technology and Science I, II. (3-0) Cr 3 each Yr Schofield Investigation in the bibliography, philosophy, and professional problems of the history of technology and science Required of all graduate students in the history of technology and science program

Courses for Graduate Students, major or minor

600. Seminar in Seventeenth and Eighteenth Century Science. (3-0) Cr. 3 Alt F, offered 1982 Schofield *Prereq Permission of instructor* Emphasis varies each time offered

601. Seminar in Seventeenth and Eighteenth Century Technology. (3-0) Cr 3. Alt S, offered 1983 Schofield *Prereq Permission of instructor* Emphasis varies each time offered

602. Seminar in Nineteenth Century Science. (3-0) Cr 3 Alt F, offered 1981 *Prereq Permission of instructor* Emphasis varies each time offered

603. Seminar in Nineteenth Century Technology. (3-0) Cr 3 Alt S, offered 1982 *Prereq Permission of instructor* Emphasis varies each time offered

604. Seminar in American Science. (3-0) Cr 3 Alt S, offered 1982 Cravens *Prereq Permission of instructor* Emphasis varies each time offered

605. Seminar in American Technology. (3-0) Cr 3 Alt F, offered 1981 Marcus. *Prereq: Permission of instructor* Emphasis varies each time offered

606. Seminar in Early Twentieth Century Science. (3-0) Cr 3. Alt. S., offered 1983. Wilson. *Prereq: Permission of instructor* Emphasis varies each time offered

607. Seminar in Early Twentieth Century Technology. (3-0) Cr 3. Alt. F, offered 1982 Marcus. *Prereq Permission of instructor* Emphasis varies each time offered

699. Research.

Home Economics Education

Ruth P Hughes, Head of Department

Professors: Beavers, Elliott, Fanslow, Hughes

Emeritus Professors: Chadderdon, Paddock

Associate Professors: Gienger, Schultz, Smith, Van Maanen, Williams

Assistant Professors: Amos, Beery, Ebert, Hausafus, Ralston, Torrie

Undergraduate Study

For undergraduate curriculum in home economics education leading to the degree bachelor of science, see *Home Economics Education* and/or *Adult Home Economics Education.*

The department offers work for the degree Bachelor of Science with curricula in home economics education. Curricula are home economics education, which prepares students for certification in vocational consumer and homemaking education and in diversified occupational home economics for grades seven through fourteen and adult home economics education, which prepares students for adult education in extension, business, and area schools and community colleges Under the home economics education curriculum, two additional options are available specific occupational areas and health education

Students may enroll in the department as sophomores. To continue in the teacher education program, students in the home economics education curriculum must apply to and be accepted by the departmental committee, the College of Home Economics Committee and the University Teacher Education Committee (For certification requirements, see *College of Education*) Students in the adult home economics education curriculum must apply to and be accepted by the departmental committee and make reservations for adult teaching experiences

Vocational Education Qualifications

The home economics education curriculum is approved by the State of Iowa Department of Public Instruction for the preparation of vocational home economics teachers

Graduate Study

The department offers work for the degrees Master of Science, Master of Education, and Doctor of Philosophy with major in home economics education. Minors are available for students who are majors in other departments

Students majoring in home economics education should have fundamental knowledge of psychology, education, sociology, and home economics. Each program of study is planned to meet individual needs.

Courses in statistics are included in the program of study for the Master of Science and Doctor of Philosophy degrees with a higher level of competence required for the degree of Doctor of Philosophy.

Open to graduate students for minor credit only: 410, 413.

Courses Primarily for Undergraduate Students

206. Introduction to Teaching Home Economics. (1-2) Cr 2 F S *Prereq Sophomore classification* Introduction to the various roles of the home economist in educational settings Microteaching and observation-participation Fee

306. An Experience in Multicultural Awareness. Cr 1 Interim Experiences designed to aid future teachers become aware of diversity of ethnic and racial groups in community and educational settings Experiences in inner city or in other racial/ethnic settings Offered on a satisfactory-fail basis only Fee

316. Occupational Home Economics. (1-0) Cr 1 F S *Prereq 400 hours in an appropriate paid work experience in paraprofessional home economics job* Organization, outlook and current trends in occupational home economics. Job analysis, coordination and evaluation techniques examined

408 Supervised Experiences in Adult or Extension Education. Cr 8 S. *Prereq 410, 411, 36 credits in home economics subject matter* Approved experiences under directors of extension or adult programs Advance reservation required

410 Educational Principles for Home Economics Offerings. (2-0) Cr 2 F S *Prereq. 20 hours in home economics subject matter* Use of principles of learning in developing instructional strategies and evaluation techniques Program development appropriate for formal and informal offerings in home economics.

411 Educational Strategies for Post-Secondary and Adult Programs in Vocational Home Economics. (0-3) Cr 1 F *Prereq. Psych 333, admission to adult program, classification in 410* Application of learning principles to the teaching of adults in formal and informal settings Practice in instructional strategies Participation in community programs Fee

412. Educational Strategies for Secondary Vocational Home Economics Programs. (0-6) Cr 2 F S *Prereq Psych 333, admission to teacher education program, classification in 410.* Application of learning principles to the teaching of home economics Practice in instructional strategies Emphasis on consumer homemaking/occupational prgrams Fee

413 Educationel Strategies for Home Economics Areas (0-3) Cr 1 S *Prereq Classification in 410* Application of methods and techniques for teaching home economics in formal and informal settings Not open to those with credit in 411, 412 Fee

417 Supervised Teaching in Vocational Home Economics. Cr 8 F S *Prereq 410, 412, 36 credits in home economics subject matter, cumulative grade point of 2 3* Supervised teaching in an approved vocational home economics program Advance reservation required

418 Supervised Experiences with Adults in an Educational Community. Cr 2 S *Prereq classification in 408* Supervised professional experience in studying the educational needs of adults of the given community Analyzing the relationships of adult educational programs sponsored by community organizations, agencies, key persons, and the public school

419 Supervised Experiences in a Public School Community. Cr 2 F S *Prereq: classification in 417* Supervised professional experience in studying educational programs outside the public school Analyzing the relationship of the public school programs to educational programs involving community organizations, agencies, and key persons in the community

420 Seminar in Home Economics Education. (1-0) Cr 1 F S *Prereq. Senior classification, 417 preferred* Examination of ways to implement, in educational settings, actions which reflect a personal philosophy of home economics Application of leadership styles to the educator's role

490 Independent Study Cr Arr
A Adult Education
C Curriculum
D Evaluation
E Extension
G General
H Honors
N Human Relations
R Vocational Education

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates.

500. Short Courses. Cr Arr SS *Prereq Permission of instructor*
A Adult Education
C Curriculum
D Evaluation
F Supervision
I Teacher Education
M Teaching Strategies

505. Workshop. Cr 1 or 2 SS *Prereq Permission of instructor* Concentrated group study of problems in fields of home economics education Sections offered will vary from year to year
A Adult Education
C Curriculum
D Evaluation
F Supervision and Administration
G General
N Human Relations
O Future Homemakers of America
P Special Needs

507. Curriculum Development in Teaching Vocational Home Economics. (3-0) Cr 3 F Alt SS, offered 1982 *Prereq Teaching experience* Application of new knowledge, career development and educational theory to curriculum planning in both consumer and homemaking and occupational programs Coordination and laboratory techniques for occupational programs included

508. Methods of Teaching Adult Vocational Home Economics. (2-0) Cr 2 S First 8 weeks *Prereq 411* Planning and organizing adult home economics education programs for young, middle-aged, and older adults Selection, use, and evaluation of teaching techniques suited to group work with adults and to informal education in home economics

511. Research Design in Home Economics Education. (2-0) Cr 2 F Alt SS, offered 1983 *Prereq Credit or classification in Res Ev 550 or Stat 401* Exploratory descriptive, analytical, experimental, and historic research designs Needed research in home economics education Planning a research study Evaluation of research reports

515. Evaluation in Home Economics. (3-0) Cr 3 S Alt SS, offered 1982 *Prereq 410* Selection and construction of evaluation devices, their use and interpretation in home economics Procedures for assessing effectiveness of programs

520. Supervision in Home Economics. (2-0) Cr 2 Alt S, offered 1982, Alt SS, offered 1983 Principles and functions of supervision emphasizing observation, conferences, and evaluation Application to student teaching, adult education experiences, state department of education, and other supervisory situations

590 Special Topics. Cr Arr *Prereq 6 credits in education or educational psycnology*
A Adult Education
B Administration
C Curriculum
D Evaluation
E Extension
F Supervision
G General
I Teacher Education
J Research Methodology
K Occupational Education
N Human Relations
P Special Needs
R Vocational Education

Courses for Graduate Students, major or minor

601. Philosophy of Home Economics Education. (1-0) Cr 1 F *Prereq H St 420, HPC 581* Integrating philosophies of education and home economics into an operative philosophy

607. Home Economics Curricula. (2-0) Cr 2 Alt F, offered 1981 *Prereq 507* Curriculum theory, development and implementation applied to home economics Current curriculum problems explored

608. Adult Education in Home Economics. (2-0) Cr 2 Alt SS, offered 1983 *Prereq 508 or experience in adult education* Philosophy of adult education in home economics Latest research findings in the field of adult and family life education Emphasis on planning family life courses for informal adult education programs

610. Seminar Cr 1 each semester F S Offered on satisfactory-fail basis only

611 Research Development in Home Economics Education. (2-0) Cr 2 Alt F, offered 1982 *Prereq 511 and Res Ev 553 or Stat 402.* Design and critique of research studies Investigate sources of external funding Proposal writing and research reporting

615. Program Evaluation in Home Economics. (2-0) Cr 2 Alt S, offered 1982. *Prereq 515.* Program and curriculum evaluation methodology Analysis of selected evaluation studies Experience with a current evaluation problem

618. Administration of Teacher Education Programs in Home Economics. Cr 1 to 2 F.S. *Prereq. Master's degree in home economics or education.* May be taken more than once for credit. Study of current undergraduate programs in home economics education, observation and participation in ongoing undergraduate courses including student teaching experiences Provides background for those preparing to assume administrative roles in teacher education Offered on satisfactory-fail basis only

620. Administration in Home Economics. (2-0) Cr. 2 Alt S, offered 1983 *Prereq. Graduate work in home economics or higher education* Study of home economics in higher education, with emphasis on land grant institutions Administrative roles and their interrelationships Discussion of current issues and trends in home economics and higher education

699. Research.

Home Economics Studies

Julia F Anderson, Chair of Department

Professors: Anderson, Elliott, Heltsley, Meixner

Professors Emeritus: Adams, Garfield, Hilton, Petersen, Rosenfeld

Associate Professors: Buchanan, Harding, Korslund

Assistant Professors: Kiser, Kruse

Instructors: Cain, Muckler, Rouse, Schuchardt, Warman

Undergraduate Study

Curriculum in International Studies in Home Economics

Designed for students interested in international studies with a basic interest in employment in cross-cultural programs overseas or in the United States

Curriculum in General Studies in Home Economics

Students are provided with the opportunity for a broad-based education with emphasis in several areas of home economics

Cross-Cultural Programs

A student wishing to develop a program that includes a cross-cultural component should check in the office of the dean, College of Home Economics

Alcorn State University Exchange Program

Students wishing to enrich their program can have an opportunity to enroll for one semester in Alcorn State University, the oldest predominantly Negro land-grant college in the United States, located in Lorman, Mississippi

Merida, Yucatan

A study program is available in cooperation with Central College in Merida, Yucatan, Mexico The program concentrates on Spanish language,

Latin American civilization, and a special problem in one of the home economics subject matter areas.

Courses Primarily for Undergraduate Students

***101. Introduction to Home Economics.** (1-0) Cr 1 F.S. Enrollment as home economics freshmen. Introduction to the scope of home economics and professional career opportunities available; identify personal values and their relationships to one's professional goals; recognize resources available to use in the process of career choices, formulation of individual plans for education and career

***202. Transfer Orientation to Home Economics.** (1-0) Cr 1 F.S. Enrollment as first semester transfer to the College of Home Economics. Emphasize transition to ISU programs, resources and procedures, highlight historical perspectives of home economics and review career opportunities; relate personal values to professional goals; formulate individual plans for education and career

210. Residential Furnishings. (3-0) Cr 3. F S. Contemporary furnishings survey; application of furniture types and styles to current uses, quality analysis of furniture and accessories

220. Commercial Furnishings. (2-0) Cr 2 S A survey of business and institution environment, commercial furniture durability specifications and public safety code requirements

330. Aesthetics and the Family. (2-0) Cr 2 F S Perspectives on the arts of the home and the community as centers for creative growth in traditional and contemporary cultures

401. The Professional's Role in Home Economics. (1-0) Cr 1 F S SS Enrollment preferred one or two semesters before graduation Role transition from student to professional in home economics, examination of activities and responsibilities as a member of the profession of home economics Survey of professional opportunities and participation in the job search process

420. History and Philosophy of Home Economics. (2-0) Cr 2 S *Prereq 15 credits in home economics* Home economics in historical perspective, definition of the profession and the practical application to society

440. Interdepartmental Seminar Cr arr F S
A General
H Honors

450. Cooperative Work-Study Program. Cr arr F S SS Offered on a satisfactory-fail basis only

490. Independent Study. Cr arr
A General
H Honors

*Credit for both 101 and 202 may not be applied toward graduation.

Courses for Graduate Students, major or minor.

540. Seminar. Cr 1-3 F S

590. Special Topics. Cr arr

Horticulture

Charles V Hall, Head of Department

Professors: Bauske, Buck, Denisen, Hall, Hodges, Mahlstede, Nichols, Weigle

Professors Emeritus: Cott, Schilleter

Associate Professors: Domoto, Kelley, Sherwood, Taber

Assistant Professors: Bhella, Christians, Gladon, Hefley, Summers, Sutter

Undergraduate Study

For undergraduate curriculum in horticulture leading to the Bachelor of Science degree, see *Horticulture, Curriculum.*

The horticulture curriculum is designed to permit commodity emphasis on general horticulture, ornamental horticulture, floriculture, fruit production, vegetable production, nursery management, or turfgrass management Specialization options complete the educational goal by combining one of the above interest areas with those skills required in production and business management, communication and public service, science or turfgrass management

The rapidly expanding field of horticulture provides employment opportunities in nurseries, florists' shops, greenhouses, garden centers, orchards, or vegetable farms. The large agribusiness industry associated with horticulture provides employment in the areas of sales and management. Turf managers are needed for golf courses, athletic fields, and parks. Further opportunities exist in sod production, landscape development and maintenance, as well as botanical gardens, conservatories, and arboretums

A new area, just beginning to grow, is the use of horticulture as a therapeutic tool in working with the emotionally ill, retarded, aging, handicapped, and disadvantaged.

Opportunities also exist for further education in graduate school to prepare for a career in research, teaching, or extension.

Students have the option of selecting a secondary major in interdepartmental programs Pest Management, Seed Science, Agricultural Extension Education, or International Agriculture. (See *Index*)

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with major in horticulture, and minor work for students taking work in other departments Under special circumstances a nonthesis master's degree is available.

Prerequisite to major graduate work is the completion of courses covering horticulture, botany, and the underlying sciences

Students taking major work in horticulture usually will take minor work in agronomy, genetics, botany (physiology, pathology, cytology, or morphology), entomology, statistics, or chemistry

There is no uniform foreign language requirement for either the Master of Science or the Doctor of Philosophy degree.

The department also cooperates in the interdepartmental program of Water Resources (See *Index*)

Open to graduate students for minor credit only: 432, 433, 442, 461, 462, 471

Courses Primarily for Undergraduate Students

110. Orientation in Horticulture. (1-0) Cr R. F Introduction to the field of horticulture

121. Indoor Plants and Gardens. (2-0) Cr 2 F S SS Methods for growing house plants, gardening in containers such as terrariums, hanging baskets, etc , interior landscaping Plant materials fee

122. Outdoor Plants and Gardens. (2-2) Cr 3 F Designing, planting, and maintaining flower, fruit, and vegetable gardens; lawn, tree, and shrub identification and maintenance.

131. Introductory Floral Design. (1-2) Cr 2 F S SS Principles, mechanics, and uses of floral arrangements, conditioning and preparation of floral arrangement material Plant materials fee.

221. Principles of Horticulture. (2-2) Cr 3 F S SS Principles of growing horticulture crops including anatomy, reproduction, light, temperature, water, nutrition, and growth and development Laboratory exercises emphasize environmental factors and permit detailed observation of plant growth.

225. Formulation and Application of Pesticides. (PM 225) (2-3) Cr 3. F Theory, mechanics, calibration, use, and maintenance of various types of equipment used in the application of pesticides for pest management and plant improvement Included are formulation, compatibility, and pesticide safety.

232. Herbaceous Ornamental Plants. (4-0) Cr 4 F *Prereq: 221.* Nomenclature, derivation, development, and classification of herbaceous and suffrutescent plants of ornamental importance in landscape planting Emphasis on environmental relationships and environment requisite to successful usage, diagnosis, and treatment of management problems

241. Woody Ornamental Plants. (2-2) Cr 3 F. Origin, identification, classification, and description of woody ornamental plants

322. Plant Propagation. (2-2) Cr 3. S *Prereq 221 or Bot 207* Fundamental principles underlying sexual and asexual propagation of plants, practice in reproducing plants by use of seeds, leaves, stems, and roots

332. Greenhouse Structures and Crops. (3-2) Cr 4 F *Prereq: 221* Production of commercial florists' major bench crops and potted plants. Structures and equipment necessary for such production

342. Landscape Establishment and Maintenance. (2-3) Cr 3. F *Prereq. 241 or LA 321* Principles and practices involved with establishment and maintenance of woody ornamental plants and turfgrasses in the landscape Selection of plant material in relationship to environmental factors is stressed

351. Turfgrass Establishment and Management. (Agron 351) (3-3) Cr 4. F *Prereq 221 or Agron 114 or Biol 109 or 110 or Bot 207.* Principles and practices of turfgrass propagation and management Specialized practices relative to home lawns, golf courses, athletic fields, highway roadsides, and seed and sod production

391. Horticultural Management Experience. Cr arr , maximum of 3. F.S.SS *Prereq: 221, permission of instructor* A structured work experience for the student to gain insight into management operations associated with production of horticultural crops A comprehensive report is required Offered on a satisfactory-fail basis only

410. Seminar. (1-0) Cr 1 F S. *Prereq Senior classification in horticulture*

432. Retail Floriculture. (2-2) Cr 3. F *Prereq 231, 332, permission of the instructor* Florists' qualifications, business aspects, professional organizations in the industry, and merchandising. Laboratories include designing and servicing floral displays and judging floral quality. Extensive reading required Fee for field trips. Plant materials fee.

433. Tropical and Subtropical Ornamental Plants. (2-2) Cr 3 S *Prereq: Bot 306.* Origin, identification, classification, and description of conservatory plants

442. Nursery Management. (2-2) Cr 3 S *Prereq: 221, Agron 154.* Equipment, including land, packing sheds, storage sheds, frames, glasshouses, and irrigation devices; transplanting and management of plants, relation to other fields of horticulture; protection of nursery plants from climatic, disease, and insect difficulties.

461. Small Fruits. (1-2) Cr 2 S. *Prereq: 221* Principles and practices involved in handling home and commercial vineyards and plantations of strawberries, bush fruits, and miscellaneous small fruits.

462. Fruit and Nut Culture. (2-2) Cr 3. S. *Prereq. 221* Principles and practices of fruit and nut culture and production. Planting, pruning, propagation, maintenance, pest control, and physiology of growth and development

471. Vegetable Crops. (3-0) Cr 3 S *Prereq: 221, Agron 154* Principles and practices of vegetable production Methods of maximizing yield and quality of vegetables Harvesting, storage, and marketing

490 Independent Study. Cr arr *Prereq Senior classification in horticulture.* Investigation of topic holding special interest to student Comprehensive report required Election of course and topic must be approved by department head
A Floriculture
B Nursery Crops
C Turfgrass
D Fruit Crops
E Vegetable Crops
F Cross-Commodity
H Honors

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

521 Controlled Plant Environments. (2-3) Cr 3 Alt SS, offered 1983 *Prereq Bot 310 or 320, Phys 111 and 112* Principles, methods, and techniques related to the measurement and control of environmental factors affecting plant growth under controlled conditions Emphasis is placed on light, temperature, humidity, carbon dioxide, water, air movement, and related factors Design and specification of a chosen controlled environment is emphasized

522 Postharvest Physiology. (2-3) Cr 3 Alt F, offered 1981 *Prereq Bot 310 or 320, B B 301* Principles, methods, and techniques related to the production and maintenance of quality of horticultural commodities Emphasis is placed on handling, storage facilities and techniques, quality evaluation, and the physiological mechanisms related to maturation, ripening, and senescence

525 Breeding and Genetics of Horticultural Plants. (2-2) Cr 3 Alt S, offered 1982 *Prereq Gen 320, Agron 421* Specialized breeding techniques and methods required for the improvement of horticultural plants and of the genetics of these plants

551 Growth and Development of Perennial Grasses. (Agron 551) (2-0) Cr 2 Alt S, offered 1983 *Prereq Bot 310 or 320* The grass plant Selected topics on anatomy, morphology, and physiology relative to growth and development of perennial grasses Emphasis on growth and development characteristics peculiar to grasses and variations of such characteristics under natural and managed conditions

561 Fruit Science (1-2) Cr 2 Alt F, offered 1982 *Prereq 462, Bot 310 or 320* Selected topics in fruit growth and development Emphasis on environmental, hormonal, and nutritional factors as related to orchard cultural practices

571 Vegetable Science. (2-3) Cr 3 Alt F, offered 1981 *Prereq 471, Bot 310, Gen 320* Review and discussion of current literature concerning genetics, physiology, and culture of vegetables with emphasis on application of current principles to vegetable production problems

590 Special Topics. Cr arr *Prereq A major or minor in horticulture*

599 Creative Component. Cr arr

Courses for Graduate Students, major or minor

610 Graduate Seminar. Cr 1 each time elected F S

624. Reproduction Physiology. (2-3) Cr 3 Alt S, offered 1983 *Prereq 332, Bot 404, 512, 513* An in-depth, critical examination of selected topics within the physiology of sexual and asexual plant propagation Physiology of phytochrome, dormancy, germination, root initiation and development, pollination, fertilization, pollen-stigma compatibilities and incompatibilities

690 Research Topics. Cr arr *Prereq A major in horticulture*

699 Thesis and Dissertation Research. Cr 1 to 11
A Floriculture
B Nursery Crops
C Turfgrass
D Fruit Crops
E Vegetable Crops
F Cross-Commodity

Housing

(Interdepartmental Minor)

G E Bivens, Chair, Supervisory Committee

Supervisory Committee: T. A. Barton, S R Greenfield, R G. Mahayni, J H Sontag

Work in housing is offered for the degrees Master of Architecture, Master of Landscape Architecture, Master of Arts or Master of Science as appropriate in the following cooperating departments or major areas. Art and Design, Architecture, Family Environment, Landscape Architecture or Community and Regional Planning

A student in housing will major in one of the cooperating departments and will develop a program for study under the guidance of a committee nominated by the advisory committee and appointed by the dean of the Graduate College.

The major professor will be in the cooperating department in which the student majors The degree will be in the major department with a minor in housing

Programs in housing should be planned to include courses from several of the following departments

Art and Design· 590E. 699

Architecture: 466, 467, 468, 507, 563, 566, 577, 590

Construction Engineering: 371, 372

Economics: 401, 402, 405, 461, 480, 565, 566

Family Environment· 412* 415*, 446*, 488* 504, 510, 519, 521, 540, 590B, 591B, 604B, 699B

Landscape Architecture: 590, 650, 699

Political Science· 410, 471, 476, 510, 512, 571, 590G

Sociology: 410, 411, 415, 464, 550, 555, 575, 576

Statistics: 401, 402, 421

Community and Regional Planning: 380*, 383*, 395*, 405*, 492*, 511, 515, 520, 524, 527, 561, 575, 590, 592

*Graduate credit not available to majors in this department.

Immunobiology

(Interdepartmental Program)

D E Reed, Chair, Supervisory Committee

Supervisory Committee: D L Harris, A Nordskog, C. D Thoen, W J Zimmerman

Work is offered for the degrees Master of Science and Doctor of Philosophy with major in immunobiology under a cooperative arrangement with the departments of Agronomy, Animal Science, Bacteriology, Biochemistry and Biophysics, Food and Nutrition, Genetics, Veterinary Microbiology and Preventive Medicine, Veterinary Pathology, and Zoology. Facilities and qualified staff exist in such areas as immunogenetics, physiology of antibody formation, cell-mediated immunity, immunochemistry, immunocytology, immunopathology, microbial immunology, immunoparasitology, and serology

A student majoring in immunobiology will choose a major professor from the graduate faculty membership of cooperating departments and will develop a program of study under the guidance of a committee nominated by the major professor, approved by the chairman of the immunobiology program, and appointed by the dean of the Graduate College.

Students desiring to do graduate work with a major in immunobiology should have a bachelor's degree or equivalent in one of the areas related to the cooperating departments listed above and should qualify for admission to one of these departments A strong background in biological sciences is required, including work in immunology, genetics, and biochemistry Students who do not have these prerequisites should plan to complete them in addition to the regular course requirements for the advanced degree Proficiency in one foreign language is required for the M S and Ph.D degrees; the same language may serve for both. Proficiency may be demonstrated by passing one year of a college-level course or by an alternative, determined by the student's program of study committee, which indicates proficiency in one foreign language For students whose native language is not English, passing English proficiency examination will fulfill the language requirement

Immunobiology students should include in their program of study a core of courses which will provide a broad coverage of the basic program in immunobiology Formal courses in immunochemistry, biochemistry, and statistics are recommended The following listing should be utilized in the selection of core courses for inclusion in the program.

Courses for Graduate Students, major or minor

489 Principles of Immunology. (VMPM 489) See *Veterinary Microbiology and Preventive Medicine*

520 Medical Immunology I. (VMPM 520) See *Veterinary Microbiology and Preventive Medicine*

520L. Medical Immunology Laboratory. (VMPM 520L) See *Veterinary Microbiology and Preventive Medicine*

560. Immunoparasitology. (VP 560, Micro 560, Zool 560) See *Veterinary Pathology*

575. Immunology. (Micro 575) See *Microbiology*

590. Special Topics. Cr 1 to 3 as arranged Offered on request *Prereq. Permission of instructor* Experimental methods applied in subdisciplines of immunobiology
A Immunochemistry
B Immunocytology
C Immunogenetics
D Immunologic Disease
E Immunoparasitology

595. Immunobiology Seminar (1-0) Cr 1 S *Prereq Permission of instructor*

615. Molecular Immunology. (B B 615) See *Biochemistry and Biophysics*

629. Medical Immunology II. (VMPM 629) See Veterinary *Microbiology and Preventive Medicine*

631. Immunologic Disease. (VMPM 631) See *Veterinary Microbiology and Preventive Medicine*

699. Research.

Industrial Administration

See Business Administration

Industrial Administrative Sciences

(Interdepartmental Program)

David B. Vellenga, Chair, Supervisory Committee

Supervisory Committee: W Q Meeker, Jr., D R. Starleaf, V. Tamashunas

Work is offered for the nonthesis degree Master of Science with a major in industrial administrative sciences under an interdepartmental arrangement. Cooperating departments include economics, industrial engineering, statistics and the School of Business Administration. A minor is offered for students majoring in areas other than industrial administrative sciences. The program of formal courses is oriented toward developing administrators or managers for all types of business and governmental organizations. Applicants need not have taken an undergraduate major in business or a related area. However, they are encouraged to obtain background in some of the following. calculus, statistics, accounting, marketing, finance, transportation, economics, industrial engineering, sociology, and psychology.

Students majoring in industrial administrative sciences will choose a major professor from the graduate faculty of industrial administrative sciences. The student's program of study will be developed with the guidance of an advisory committee selected by the student and the major professor, approved by the chairman of the Industrial Administrative Sciences Supervisory Committee, and appointed by the dean of the Graduate College The program total of 36 semester credits includes work in the areas of human resource management, quantitative methods, economics, the business environment; applications (production, accounting, marketing, transportation and logistics, and finance); business policy; and electives. The program agreed upon by the student and the student's committee shall include a sufficient number of 500 and 600 level courses to be consistent with quality graduate work on the master's level Although this is a nonthesis degree, a creative component is required of each student. This is accomplished by taking a minimum of three credits in special topics from one of the cooperating departments.

Students minoring in industrial administrative sciences shall have a faculty member representing the interdepartmental program on their committee At least six courses, one-half of which are on the 500 level, shall be selected from designated course offerings in at least two of the cooperating departments. A minimum of two courses must be included from courses chosen in any of the cooperating departments. A minor cannot include courses that are offered by the department in which the student is a major

Submission of Graduate Management Admission Test or Graduate Record Examination aptitude test scores is required when seeking admission as a major in the program.

A partial listing of required or recommended courses for a major in industrial administrative sciences is as follows:

Human resource management — selection to be made from Econ 596; I E 424; 425; Psych 450, 451.

Quantitative methods — selection to be made from I E 511, 518, Stat 402, 432, 539.

Economics and the business environment — Econ 495, 496, and Mgmt 510 required.

Applications in business — required courses include Mkt 540, Fin 550, TrLog 560, Acct 580, and one industrial engineering production course, I E 551

Business policy — Mgmt 578 required

Electives — courses are selected from the cooperative department and numerous complementary areas.

Industrial Education

William D. Wolansky, Head of Department

Professors: Miller, Parks, Sherick, Wolansky

Professors Emeritus: Carver, Wiener

Associate Professors: Arcy, Beno, Gelina, McKay, McPherson, Riley, Van Ast, Watkins

Assistant Professors: Bortz, Muench, Paige, Smith, Weber, Younger

Instructors: Brock, Hurst, Jorgensen, McConeghey

Undergraduate Study

For the undergraduate curriculum in industrial education leading to the degree Bachelor of Science, see *College of Education, Curricula*.

The industrial education curriculum provides essential preparation for students who have a strong aptitude and interest in careers related to teaching and industry Students have the opportunity to study in programs leading to certification to teach industrial arts in junior or senior high schools, or to secure industrial vocational-technical certification with endorsement 71 or teaching driver education, or to gain employment in industry in the areas of personnel, sales, communications, construction, service, production, and occupational safety

In the teaching specialization, the student must apply for admission to the teacher education program and be approved by the teacher education committee in industrial education and by the University Committee on Teacher Education, College of Education. For admission and certification requirements, see *College of Education*

Graduate Study

The department offers work for the degrees Master of Science, Master of Education, and Doctor of Philosophy with major in industrial education, and minor work for students taking major work in other departments. Within the industrial education major, a student may specialize in industrial vocational-technical education, industrial education, or occupational and traffic safety education.

Prerequisite to major graduate work is preparation equivalent to the completion of the undergraduate curriculum in industrial education at Iowa State University and adequate proof that the student ranks above average in scholastic ability. The student must also possess adequate promise as a leader within the profession

Though the department stipulates no foreign language requirement for either the Master of Science or Doctor of Philosophy degree, it may be relevant in individual cases to specify competence in one or more languages Students not electing the thesis option, master's degree level, will be required to complete a minimum of 3 credits of a creative component project.

The department participates in the interdepartmental program in Technology and Social Change. (See Index.)

Open to graduate students for minor credit only: I Ed 464

Industrial Education (I Ed)

Courses Primarily for Undergraduate Students

110. Introduction to Industrial Education. (1-0) Cr 1 F S Qualifications, opportunities, preparation, and duties of workers in industrial arts, vocational industrial education, occupational safety, and industry Philosophy, structure, and goals of the department will be examined Satisfactory-fail

120. Introduction to Graphic Communications. (1-4) Cr 3. F S An introduction to the area with emphasis on the systems approach, technical graphics and photographic concepts

130. Introduction to Materials and Processes. (1-4) Cr 3 F S. An introduction to selected industrial materials and processes used in manufacturing Laboratory and lecture activities focus on industrial materials and processes. Fee

140. Introduction to Energy. (3-0) Cr. 3. F.S Survey of energy sources with emphasis on ecology, consumerism, alternate energy, energy conservation, storage, transmission, and transportation.

217. Introduction to and Observation in Industrial Arts Teaching. (1-2) Cr 2 F.S. Observation and active participation in actual teaching situations with emphasis on the professional industrial arts teacher's philosophy and life style An analysis of the student's career interests and capabilities.

221. Graphic Image Generation. (1-4) Cr 3 F S Industrial applications in the concepts and practices of graphic image generation technology Line lithography, photo screen techniques.

222. Graphic Conceptualization. (1-4) Cr 3 *Prereq 221* Rapid generation of new ideas through graphic images and theory of mechanical pictorial drawings

224. Industrial Design Graphics. (1-4) Cr 3 *Prereq 221* Study of technical graphics and industrial applications and practices

227. Graphic Image Reproduction. (1-4) Cr 3 *Prereq 221.* Simulated industrial experiences dealing with graphic image reproduction processing and management methods.

231. Industrial Materials and Processes. (1-4) Cr 3 F S *Prereq: 130.* Intermediate study of selected materials and processes used in manufacturing. Industrial materials, processes, and management Fee

233. Materials Testing and Processing. (2-2) Cr 3 *Prereq. 231.* Materials, material testing, and material processing as utilized in the manufacturing and construction industries.

235. Management of Materials and Processes. (1-4) Cr 3 *Prereq 231* Theory and application of the mass-production enterprise system and management techniques used in industry. Fee

240. Basic Electrical Energy. (1-4) Cr 3 F.S *Prereq 140* Introduction to sources, transmission, and utilization of electricity, emphasis on DC and AC circuit theory. Passive components, active circuit elements, test gear, and tools for students in industrial and technical education Fee

241. Introductory Energy Systems. (1-4) Cr 3 Survey study of energy sources and systems within the automobile; emphasis on ecology, consumerism, alternate energy, conservation, storage; use of test equipment for electrical, mechanical, fluid systems Designed for non-major Fee

242 **Energy Applications.** (1-4) Cr 3 *Prereq 140, 240* Conversion transmission, control of energy; emphasis on practical industrial applications

245 **Basic Energy Conversion Systems.** (1-4) Cr 3 *Prereq 140, 240* Theory of conversion systems utilizing internal and external combustion engines integrated systems, maintenance, use of test equipment and tools, ecological aspects Fee

260 **Theory of Flight.** (3-0) Cr 3 F Aviation weather, federal aviation regulations, aircraft performance, navigation and aerospace utilization, use of flight computer and plotter, and medical factors for pilots Upon completion of the course, students are expected to pass the Federal Aviation Administration Private Pilots Airplane Written Examination

265 **Basic Flight Laboratory.** (0-3) Cr 1 *Prereq Credit or classification in 260 and permission of Chief Flight Instructor* Flight maneuvers and procedures necessary for solo flight operations 20 hours of flight time Lab fee approximately $500 00

267 **Advanced Flight Laboratory.** (0-3) Cr 1 *Prereq 260, 265 and permission of Chief Flight Instructor* Cross-country flying using pilotage, dead reckoning, and radio navigation, night flying 25 hours of flight time to meet the experience requirements for the Private Pilot Certificate Lab fee approximately $600 00

310 **School Laboratory Safety.** (3-0) Cr 3 *Prereq Junior classification* Analysis of accidents and accident prevention in the secondary school industrial education laboratory Iowa Occupational Safety and Health Act (CFR 1910) and how it applies to Iowa schools Methods of initiating an effective accident prevention program

311 **Industrial and Construction Safety.** (Con E 311) (2-0) Cr 2 S Survey of the Federal and Iowa Occupational Safety and Health Act. Regulation and control of working environment of all employees with emphasis on the construction industry and on the current Federal Register 1926

312 **Foundations of Industrial Arts.** (3-0) Cr 3 F Historical and philosophical foundations of industrial arts education Includes contemporary movements of the 60's and curriculum development procedures for industrial arts

322. **Graphical Analysis.** (1-4) Cr 3 *Prereq 224* A graphical analysis of spatial relationships between points, lines, and planes

325 **Construction Detailing.** (1-4) Cr 3 *Prereq 224* Concepts and techniques used in building and construction industries Emphasis on construction details, specifications, and mechanical systems for residential construction

326. **Industrial Design.** (1-4) Cr 3 *Prereq. 222* Product and three dimensional problem solving and design techniques as applied to industrial settings

327 **Planographic Reproduction.** (1-4) Cr. 3 *Prereq 227* Concepts and practices of multi-color planographic reproduction

328. **Screen Process Reproduction.** (1-4) Cr 3 *Prereq 227* Methods, concepts, and industrial practices of screen process reproduction

334 **Metal Processes.** (1-4) Cr. 3 *Prereq 231* Principles and practices of bench metalwork, forging, heat treatment, welding, casting, pattern making, and sheet metal fabrication Fee

335 **Materials and Processes of Construction** (0-3) Cr 3 *Prereq 231* Basic construction principles and practices including the use of hand and power tools, applications of constructional materials, and safety practices in the construction industry Fee

338. **Modern Materials: Design and Construction** (1-4) C 3 *Prereq. 231* Advanced design and construction as applied to furniture, cabinet making, sporting equipment, and specialized items Fee

342. **Electrical Energy Applications.** (1-4) Cr 3 *Prereq 140, 240* Power supplies, amplifier and oscillator circuitry for communications and control systems Closed-loops, digital and analog circuits, design and fabrication methods, circuit testing and analysis for students in industrial and technical education Fee

346. **Energy Systems Assessment.** (1-4) Cr 3 *Prereq 240* Modern energy systems, the relationship to society, advances in energy technology, the future of energy utilization, ecology, economics. For industrial education students. Fee

380 **Supervised Industrial Cooperative Experience.** Cr 1 to 3 each time elected, no more than 9 total, F S SS *Prereq Classification in industrial education, permission of cooperative coordinator* Supervised work experience in industry

410. **Facility Planning and Management in Industrial Education.** (2-2) Cr 3 Principles and practices in evaluating and reorganizing existing facilities, purchasing materials and maintenance of equipment

415. **Methods of Teaching Industrial Arts.** (3-2) Cr 3 F S *Prereq 312* Methods and techniques of teaching industrial arts, objectives, organization of subject matter, relationships, and evaluation Field trips to schools Preteaching laboratory experiences including microteaching

417. **Supervised Student Teaching.** A Junior high school industrial arts. Cr 8 B Senior high school industrial arts Cr 8 *Prereq 415* Opportunity to experience and observe the life styles of teachers and to put into practice and develop competence in methods and techniques of teaching, seminars to enrich experiences

421 **Industrial Illustration** (1-4) Cr 3 *Prereq 222* Methods and media of illustrating pictorials for industrial use

423. **Manufacturing Design Graphics.** (1-4) Cr 3 *Prereq 322* Preparation of working drawings for communicating new design ideas for machines, jigs, and fixtures, and other mechanical apparatuses as utilized in the manufacturing process

425. **Construction Design Graphics.** (1-4) Cr 3 *Prereq 325.* Emphasis on the design process and presentation methods of residential construction as taught in the secondary schools

430 **Industrial Plastics** (1-4) Cr 3 *Prereq 231* Plastics materials and processes Tool design and production considerations of molding, forming, coating, and other plastics manufacturing processes Fee

436. **Machine Metals Processing** (1-4) Cr 3 *Prereq 231* General machine-tool operation, emphasis on advanced set-ups on machine tools, including precision grinding, measurement, and related welding, casting, tool and die Fee

442. **Advanced Electrical Energy Applications.** (1-4) Cr 3 *Prereq 342* Current electrical/electronic circuitry with emphasis on microcomputer systems design fabrication, testing, applications Fee

445 **Integrated Mechanical/Fluid Systems** (1-4) Cr 3 *Prereq 245* Modern mechanical/fluid power systems Emphasis on control and utilization Fee

464 **Aerospace Workshop for Educators** (2-2) Cr 3 Aircraft, weather, navigation, and governmental regulations related to the fields of aerospace and aviation

480 **Industrial Enterprise System** (1-4) Cr 3 *Prereq 30 credits in industrial education* Simulation of mass production in industry with emphasis on management, personnel, research and development, production, marketing, and servicing of consumer products Students participate in a product manufacturing corporate structure Fee

490 **Independent Study in Industrial Education.** 1-5 credits
A Industrial Education
B Professional Methods
C Curriculum
D Drafting, Design, Planning
E Electricity - Electronics
F Instructional Methods
G Technical Training
H Honors
M Metals
P Power
R Plastics
T Safety, Industrial Education
W Wood Technology

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

Prior to registration for graduate level vocational certification courses, the student shall be classified as a senior or have an earned bachelor's degree, and be required to complete additional assigned readings, term papers, and graduate projects

502. **Applied Techniques in Materials and Processes.** (2-4) Cr 4 *Prereq 10 credits in industrial education* Classroom simulation of industry and study of the production process Students participate in a profit-making corporate structure involving manufacture of hard goods. Exploration of management, systems, controls, financing and personnel

528 **Human and Public Relations for Industrial and Technical Education.** (2-0) Cr 2 *Prereq IVTE 514* Identifying a plan of public relations for industrial and technical education, analysis of publics that need to be reached, effect of human relations on public relations, criteria for evaluating public relations.

532. **Industrial Arts and Technology for Children.** (2-2) Cr 3 *Prereq 10 credits in elementary education or industrial education* Development of elementary school programs in industrial arts Identification of psychomotor and developmental factors in children related to tool and material manipulation Integration of technology concepts into the elementary school curriculum Use of industrial arts concepts to facilitate concept mastery in other disciplines

550 **Industrial and School Shop Safety.** (3-0) Cr 3 *Prereq 310* Safety as it pertains to the industrial arts and industrial vocational-technical teachers. OSHA and IOSHA regulations and the standards as required by OSHA and IOSHA

554 **History and Philosophy of Industrial Education.** (3-0) Cr 3 *Prereq 312* An evaluation of educational and industrial thought Historical and philosophical development of industrial education to the present, trends and implications

555. **Administration and Supervision of Industrial Education.** (3-0) Cr 3 *Prereq 417* Administration, supervision, curriculum development, selection of staff, and public relations Evaluating administrative and supervisory efforts, program modification Field trips to schools and industries

557 **Organization and Management of the Industrial Education Laboretory.** (3-0) Cr 3 *Prereq 410* Principles and practices involved in the planning, organization, and management of the school shop, responsibilities of the school administrator and teacher, basic principles of planning, selection and purchase of machine tools, equipment and materials, maintenance, storage and control of machines, tools and equipment, managing the shop for effective work

561 **Advanced Topics in Power and Energy.** (2-4) Cr 4 *Prereq 442* Development of integrated systems utilizing fluids, electrical and mechanical components Experimentation in alternative energy systems, system evaluation for efficiency and cost-effectiveness Utilization of computers in real-time system monitoring and control of power and energy systems

580. **Advanced Topics in Graphic Communications.** (2-4) Cr 4 *Prereq 425.* Exploration of computer graphics Advanced design and drawing applications Integration of aesthetic, function, cost, and human factors specifications in product design, evaluation of product design Opportunity for individual creativity and specialization in an area of graphics

581 **Advanced Topics in Materials and Processes.** (1-4) Cr 3 *Prereq 502* Utilization of industrial materials including wood, metals, plastics, and ceramics, use of automation in manufacturing and quality control Opportunity for specialization in the area of materials and processes.

590. **Special Topics in Industrial Education.** Cr. 1-4 *Prereq. Graduate classification in industrial education.* Special topics in industrial education administration, curriculum, evaluation, research, history, safety, technical education, etc

593. **Workshop in Industrial Education.** Cr 1 to 3. *Prereq 15 credits in industrial education.*

599. **Creative Problem.** Cr 1-3. A discipline-related problem to be identified and completed under the direction of the program adviser Three credits required for all nonthesis master's degree students.

Courses for Graduate Students, major or minor

615. **Seminar.** Cr 2-3 *Prereq Credit or classification in 401*

644. **Futuristics in Industrial Education.** (3-0) Cr 3. *Prereq. Graduate classification, permission of instructor* A critical analysis of industrial education in changing roles and requirements of education Future alternatives for industrial education with relationship to society, education, and technology.

652. **Program and Student Evaluation.** (3-0) Cr 3 *Prereq: 491* Developing basic concepts of evaluation Techniques for evaluating student personnel, facilities, programs, staff, and other educational resources

653. Research and Development. (3-0) Cr 3 *Prereq. Completion of master's degree and introductory statistics* Examination of industrial R & D practices and procedures, product development standards, advanced product testing and research designs

656. Instructional Materials for Industrial Education. (3-0) Cr 3 *Prereq Sec Ed 301 and 10 credits in industrial education* Examination of new equipment, materials and techniques in using instructional materials in industrial education teaching

657. Curriculum Development In Industrial Education (3-0) Cr 3 *Prereq 15 credits in industrial education* Basic concepts, trends, practices, and factors influencing curriculum development, techniques, organization and procedures, the course of study and its development in a given curriculum pattern

699 Research Arr (3-14)

Industrial Vocational-Technical Education (IVTE)

Courses primarily for Undergraduate Students

300 Occupational Competency Cr up to 30 semester hours *Prereq Approval of department head,*, enrolled in B S degree (IVTE) and have planned program leading to endorsement 71, have met the industrial experience requirement for vocational approval, have junior classification, have completed 10 semester credits at ISU prior to receiving credit for occupational competency Competency in the following occupational clusters is determined through completion of oral, written, and performance examinations See Industrial Education Department Competency Test Program guidelines for additional information

A Automotive and Power Mechanics
B Building Trades
C Commercial Art
D Drafting and Graphics
E Electricity-Electronics
F Metal Trades

380. Orientetion to Teaching Industrial Vocational Technical Education Programs. (3-0) Cr 3 Orientation to industrial vocational teacher education with basic skills necessary for the beginning teacher and experiences in teaching IVTE subjects, evaluation and laboratory management, career and instructional materials development

381 Foundations of Industrial Vocational Technical Education (3-0) Cr 3 *Prereq 380* Development and philosophy of industrial vocational-technical education, career development practices, federal and state legislation State plans, divisions, types of programs, and the organization, administration, and financing of secondary and post-secondary industrial vocational-technical education programs

382. Occupational Analysis and Course Construction in Industrial Vocational-Technical Education. (2-0) Cr 2 *Prereq 380* Course of study development based on occupational analysis and career needs Compilation, arrangement, and limitation of instructional materials

383. Techniques of Teaching Industrial Vocational-Technical Education. (3-0) Cr 3 *Prereq 380* Teaching processes, methods of presentation, testing, lesson planning, organization of instruction, execution of instruction, and instructional materials

384. Facility Planning, Organization and Management of Industrial Vocational-Technical Education. (4-0) Cr 4 *Prereq 380* Principles, practices and problems in planning, organizing and managing schools and laboratories in industrial vocational-technical education

490. Independent Study in Industrial Vocational-Technical Education. Cr 1 to 5 *Prereq Junior classification, quality-point average of 2 5 or more for two preceding quarters*

A Adult/IVTE
B Vocational-Technical
C Curriculum/IVTE
D Evaluation/IVTE
E Special Needs/IVTE
F Instructional Materials/IVTE
G Laboratory Problems/IVTE
I Technical Training/IVTE
J Administration

491. Evaluation in Industrial Vocational-Technical Education. (2-0) Cr. 2 *Prereq. 380.* Instruction, instructor, student, and program evaluation with the purpose of improving the total effectiveness of instruction

492. Coordination and Administration of Industrial Vocational-Technical Education. (3-0) Cr 3 *Prereq 380* Principles of organization, coordination, and administration of cooperative education with business and industry to provide part-time, on-the-job training, and career development experiences

493. Human and Public Relations for Industrial Vocational Technical Education. (3-0) Cr 3 *Prereq 380* Identifying, administering, and supervising a plan of human and public relations for industrial vocational and technical education, analysis of publics that need to be reached, effort of human relations on public relations, criteria for evaluation

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates.

510. Techniques of Teaching Vocational and Technical Education. (2-0) Cr 2 *Prereq 380* Teaching processes, methods of presentation and testing, lesson planning, and organizational instruction

514 Foundations of Vocational and Technical Education. (2-0) Cr 2 *Prereq Psych 333* Development and philosophy of vocational-technical education, federal and state legislation State plans, divisions, and types of programs

519 Occupational Analysis and Course Construction. (2-0) Cr 2 *Prereq 510* Course of study development based on occupational analysis Compilation, arrangement, and limitations of instructional materials

522. Evaluation in Industrial Vocational-Technical Education. (2-0) Cr 2 *Prereq 510* Theory and application of evaluation methods unique to vocational-technical educational programs

524. Conference-Leading Techniques. (2-0) Cr 2 *Prereq 510* Conference procedures and techniques as applied to teaching and advisory committee functions

525. Coordination of Cooperative Education (2-0) Cr 2 *Prereq 510* Principles of organization, coordination, and administration of cooperative education with business and industry to provide part-time on-the-job training for students

530 Administration and Leadership in Industrial Vocational-Technical Education (3-0) Cr 3 *Prereq 514* Administration and leadership styles, theory of administration, and applications to vocational-technical education

536. Legislative and Financial Aspects of Industrial Vocational-Technical Education. (3-0) Cr 3 *Prereq 514* Legislative and financial guidelines and practices at the local, state, and federal levels as they relate to secondary and post-secondary vocational programs, students, and staff

549. Internship in Industrial Vocational-Technical Education. (arr) Cr 1-4 *Prereq 10 hours in industrial education* Emphasis on full experience in industrial vocational education as it relates to administration-supervision, special needs, curriculum-instruction, and evaluation-research

590 Special Topics in Industrial Education. Cr 1-5 *Prereq Graduate classification in industrial education*

A Adult/IVTE
B Vocational-Technical
C Curriculum/IVTE
D Evaluation/IVTE
E Special Needs/IVTE
F Instructional Materials/IVTE
G Laboratory Problems/IVTE
I Technical Training/IVTE
J Administration

Safety Education and Driver Education (Saf)

Courses Primarily for Undergraduate students

10 Driver Education. (1-2) Cr 0 F S SS Classroom, laboratory, and on-street experience in operating a motor vehicle Register directly through Safety Education Fee $40 00

20. Motorcycle Rider Course. (1-2) Cr 0 F S SS Classroom, laboratory, and on-street experience for beginning motorcyclists Register directly through Safety Education Fee $30 00

201. Principles of Accident Prevention. (3-0) Cr 3 F S Basic foundations of accident causation in home, traffic, public, and work environments

202. Occupational Safety. (3-0) Cr 3 F S *Prereq 201* Introduction to industrial accident prevention as it relates to health and safety

208. Highway Transportation System-Driver Task Analysis. (2-1) Cr 3 F The highway transportation system with specific treatment of the vehicle operator task.

210. Accident Investigation and Records. (3-0) Cr 3 S *Prereq. 201* The procedure for investigating causes of work and motor vehicle accidents

315. Handling of Products and Hazardous Materials (3-0) Cr 3 S *Prereq 202* The manual and mechanical handling procedures of products and materials and the storage of hazardous chemicals

317 Theory and Practicum of Multiple-Car and Behind-the-Wheel Instruction (1-4) Cr 3 F *Prereq 201* Operational procedures of an off-road driving facility and the coordination of the behind-the-wheel instruction for beginning drivers

330 Legal Aspects of the Occupational Safety and Health Acts (3-0) Cr 3 S *Prereq 202* Legal implications of legislation as it applied to health and safety in the work place

360. Fire Protection and Prevention. (3-1) Cr 3 S *Prereq 202* Causes and prevention of industrial fire accidents

401 Perception and Safety. (3-0) Cr 3 S *Prereq 201* Accidents and their causes relative to the five human senses to ascertain preventive measures

415 Theory and Practicum of Classroom Instruction (3-0) Cr 3 S *Prereq 317* Investigation of content methodology, and evaluation of classroom instruction Experience includes observation and actual teaching experience

416. Theory and Practicum of Simulation and Behind-the-Wheel Instruction (2-4) Cr 4 S *Prereq 317* Operational procedures of a driving simulator lab and behind-the-wheel instruction for beginning drivers

420 Motorcycle Safety Instruction (1-4) Cr 3 F *Prereq 201* To prepare instructors for teaching a beginning motorcycle rider course including classroom and on the motorcycle

430 Safety Internship Cr 1-4 F S *Prereq 201, 416 or 471* The practical learning experience as a continuum of a student's formal education in occupational and traffic safety education

470. Industrial Hygiene. (3-0) Cr 3 F *Prereq 202* Health related problems found in an industrial setting Toxic chemicals, ventilation and noise problems

471 Instrumentation for Industrial Hygiene. (1-4) Cr 3 S *Prereq 470* The use and calibration of instruments to measure the quality and quantity of contaminants in the work environment

490 Independent Study in Occupational and Traffic Safety Education. Cr 1-4 F S To provide a mode of learning to meet individual needs of a student in the field of accident prevention *Prereq 201, quality-point average of 2 5 or more*

A Administration
B Legislation
C Curriculum
D Data Analysis Research
E Occupational Safety
F Technical Writing
G Traffic

Courses Primarily for Graduate Students, open to qualified undergraduates

500. Administration of Accident Prevention Programs (3-0) Cr 3 F *Prereq 315 or 317* Procedures for organizing and administering an occupational and traffic safety education program

515. Curriculum Development for Safety Programs. (3-0) Cr 3 S *Prereq. 315 or 415* Theory and principles of content selection, methodology, and evaluative techniques applicable to traffic and occupational safety

541. Safety Symposium. (1-0) Cr 1 F *Prereq 9 hours in safety education* A broad overview of the entire field of safety through outside readings by the classroom participants

590. Special Topics in Safety Education. (Arr) Cr 1-3 Applications of safety education principles to special topics such as motorcycle, bicycle, industrial, household, traffic, etc Individualized instruction in area of major interest and concentration

593 Workshop in Occupational and/or Traffic Safety Education Cr 1-4 *Prereq. 15 credits in occupational and/or traffic safety education*

599 Creative Component. Cr 3 A discipline-related problem to be identified and completed under the direction of the program adviser Three credits required for all nonthesis master's degree students

Industrial Engineering

Keith L McRoberts, Chair of Department

Professors: Berger, Cowles, David, Griffen, McRoberts, Montag, Moore, C E Smith, G W Smith Tamashunas, Vaughn

Emeritus Professors: Hempstead, Hilliard, Kleinschmidt, Squires, Walkup

Associate Professors: Adams, Barta, Classen, Even, Harmison, Hendricks, Lamp, Love, Malstrom, Meeks, Mohr, Park, Watkins

Assistant Professors: Eichner, Grant, Sjobakken, Theile

Undergraduate Study

For undergraduate curriculum in industrial engineering leading to the degree, Bachelor of Science, see *College of Engineering, Curricula*

The industrial engineering curriculum prepares persons who have strong aptitudes in engineering and a potential capacity for management for challenging careers in planning, controlling, designing, and managing complex industrial organizations for efficient operation

Professional services performed by industrial engineers include: line management, facilities planning, cost and economic analysis, safety engineering, industrial relations, quality control and reliability, inventory and production control, facilities and methods design, work measurement, operations research, information systems design, technical sales, and personnel supervision

The curriculum includes a thorough foundation in the physical, mathematical, and engineering sciences, analysis, synthesis and design Since the industrial engineer deals with people, courses in social and humanistic subjects are included This foundation prepares the graduate for positions in industry, government or graduate work in any of the specializations described in the section of graduate study The curriculum is normally completed in four years

A five-year cooperative program is available in the Industrial Engineering Department See *Cooperative Programs, College of Engineering*

Graduate Study

The department offers work leading to the degrees of Master of Engineering and Master of Science with majors in industrial engineering and engineering valuation, the degree of Doctor of Philosophy with major in engineering valuation, and minor work to students taking major work in other departments Graduate work is designed to improve the student's ability in the professional practice of industrial engineering and to develop research capability

The prerequisite to major graduate work is the completion of a curriculum substantially equivalent to that required of undergraduate students in engineering at this institution

With the help of a program of study committee, a graduate student designs an educational program in areas within industrial engineering and engineering valuation Typical areas of concentration include engineering economics and capital budgeting, management science, management and regulation of public utilities, systems analysis and control, production systems analysis and design, human resources management, life analysis and depreciation, industrial property valuation, operations research and optimization, management information systems design, safety engineering, human factors engineering, and legal aspects of engineering administration A specialization in operations research leading to a Master of Science degree is co-offered with the Department of Statistics

The department also participates in the following interdepartmental programs Industrial Administrative Sciences, Industrial Relations, Energy Systems Engineering, Technology and Social Change and Transportation Planning (See Index)

Open to graduate students for minor credit only 304, 312, 333, 341, 361, 374, 375, 404, 407, 421, 423, 424, 425, 441, 443, 462

Courses Primarily for Undergraduate Students

100 Technical Lecture (1-0) Cr R S Lectures and conferences designed to aid the freshman student to adjust both in course and in college environments

209 Industrial Computer Techniques (2-3) Cr 3 F S *Prereq Com S 172* Computer operations, remote terminal use, programming techniques, remote job entry systems, simulation language, and use of library programs

*250 Introduction to Industrial Engineering (2-0) Cr 2 F S *Prereq Math 165* Introduction to the design and control of production systems Engineering economy plant location and layout work design and measurement, production and inventory control, critical path scheduling

274 Ergonomics in Work System Design (2-0) Cr 2 F S *Prereq 250* Using the ergonomics approach in physical and psychological aspects of workplace and task design and development Investigation of basic human physiology, biomechanics, regulatory legislation, worker protection, workplace design, and environmental stress from heat, noise, vibration, and illumination in person-machine systems

293. Seminar (1-0) Cr R F S *Required of all second-semester sophomore students* Required of transfer students in the first semester after transfer to the Industrial Engineering Department

298, 398, 498. Cooperative Education Cr R F S SS Required of all cooperative education students *Prereq Permission of department chairman* 298 Work periods for students with sophomore standing in a regularly established program 398 Work periods for juniors 498 Work periods for seniors Students must register for these courses prior to commencing each work period

*304. Analysis for Engineering Economy (2-0) Cr 2 F S *Prereq Junior classification and Com S 172* Engineering/managerial analysis of the economic aspects of public and private project proposals Decisions involving the expenditure of capital funds Alternative sources of funds time value of money, methods of evaluating alternative projects

312. Industrial Operations Research. (4-0) Cr 4 F S *Prereq 209, 250, Math 266, credit or classification in Stat 231* Concepts, analysis techniques, optimization techniques, and applications of operations research to industrial engineering Construction and optimization of models for industrial systems using linear programming, queueing theory, and simulation Use of problem-oriented languages such as MPS, GPSS, and FORTRAN in solving problems

333. Computer Graphics. (2-0) Cr 2 or 3 S *Prereq Com S 172 or 112* Techniques for graphical man-machine communications Use of available facilities Graph plotting, two-dimensional and three-dimensional applications Requirements and applications for interactive graphic communications Individual projects The optional third credit allows a project

341. Material and Project Control. (3-0) Cr 3 F S *Prereq 312* Analysis of inventory systems and sequencing and scheduling problems in the control of material flow with applications in industrial systems Material requirement planning and project control techniques such as PERT and PERT/COST systems are included Construction of mathematical models, use of heuristic techniques, and use of problem-oriented languages such as FORTRAN in solving problems. Project involving design of material control systems required

350 Entrepreneurship for Engineers. (2-0) Cr 2 S *Prereq Junior classification in engineering* An introduction to and guidelines for those students interested in private engineering enterprise Includes the organization of an engineering business venture, personnel and labor management, financial ratios and policies, forms of ownership, market analysis, etc Case studies, outside readings, and guest speakers

352. Health Care Management Engineering. (3-0) Cr 3 S *Prereq 250 or 375 and Math 165, Stat 105.* Hospital organization and alternate health care delivery systems, the functions of various hospital departments and their productivity measures, the principles of hospital management engineering and applications, various case exercises in use of industrial engineering in health care field

361 Industrial Quality Control and Inspection. (3-0) Cr 3 F S *Prereq 250, Stat 231* Techniques for obtaining measurements on industrial products and the statistical treatment of data to assure quality Project involving the design of quality system

*373 Methods Engineering and Work Measurement. (2-3) Cr 3 F S *Prereq 250, Stat 231* Principles of motion economy and work simplification in work center design Man-machine relationships Measurement tools for direct and indirect work Formula construction for time determination of variable elements

374 Industrial Methodology. (2-0) Cr 2 F S *Prereq 250 or 375, M S E 271* Analysis of industrial methods including fabrication, forming, cutting, welding, assembly inspection and finishing methods Tooling methods including numerical and computer control of machines Development of the manufacturing process from the economic aspect

*375 Industrial Organization and Work Analysis (3-0) Cr 3 F S *Prereq Junior Classification* Industrial ownership, types of organizations The principles and methods of production control, inspection, wage systems, cost control, with special emphasis on work analysis, methods and measurement

393. Industrial Inspection Trip. Cr R F S *Prereq Junior industrial engineering classification* On-site visitation and inspection of various industrial facilities to gain background on various industrial functions and the IE's role in research, planning, and operations Fee

*404 Engineering Economy. (3-0) Cr 3 F S *Prereq Econ 201, Acct 381* Application of fundamentals of economics to engineering alternatives in planning, developing, and managing industrial projects

407. Engineering Valuation. (3-0) Cr 3 F S *Prereq Econ 201, 2 credits in accounting* Concepts of value, original cost, and reproduction cost, property records, methods of estimating depreciation for valuation and accounting, intangible values, cost values, earning values, rate base, and valuation for taxation, rates, financing, insurance, and sales

420 Engineering Sales. (2-0) Cr 2 F *Prereq 304, 424, and either 480 or Mgmt 315* Requirements for entry into the field of sales engineering, the relationship of sales engineering to other fields such as contract administration, purchasing, and marketing

421. Safety Engineering. (2-0) Cr 2 F *Prereq. 250 or 375* Principles of hazard identification and accident prevention in the work environment Hazards and their control to reduce risk of accident/illness. Incentives to provide a safe working environment including economic and legal aspects

423. Industrial Compensation. (2-2) Cr 3. F *Prereq. 250 or 375* Practices and procedures for designing and administering compensation systems utilizing job evaluation, performance rating, and wage survey Incentive programs and employee benefit packages analyzed

424. Human Resource Management. (1-2) Cr 2. F S SS. *Prereq. 250 or 375.* Employer-employee problems and approaches to their solution utilizing behavioral science concepts Emphasizes the

organization, motivation, and management of human resources, and principles and techniques of selection and placement, personnel development and evaluation, and union-management relations

425. Socio-Technical System Design. (2-2) Cr 3 F S *Prereq. 424* Design of work systems recognizing socio-technical impact on job design, productivity, organization planning, and change Emphasizes developing work environments concerned with quality of working life

441. Industrial Engineering Design. (3-6) Cr 5 F S *Prereq: 312, 373, 404* Production planning and design of physical facilities for processing including site selection, material handling, equipment specification and layout, plant engineering and maintenance Design of budgetary and cost controls for facility

443. Industrial Materials Handling. (2-0) Cr 2 F *Prereq 373, 312* Analysis and application of mobile, fixed path, and semi-fixed path material handling equipment to industrial processes Material handling relationships to packaging, warehousing, and physical distribution

462. Industrial Systems Engineering. (3-0) Cr 3 S *Prereq 209, Stat 231* Application of mathematical and statistical techniques to the synthesis and analysis of industrial engineering problems Use of computer methods for analyzing data and studying properties of industrial systems models

480. Engineering Law. (3-0) Cr 3 F S *Prereq Junior classification* Introduction to jurisprudence, judicial procedure, contract essentials and principles, torts, real property, sales, agency, workmen's compensation, safety, intellectual property

490. Independent Study. Cr 1 to 5 each time elected *Prereq: Senior classification, permission of instructor* Independent study and work in the areas of industrial engineering design, practice, or research
A Valuation, Depreciation, and Engineering Economy
B Human Resource Management
C Industrial Engineering
D Regulated Industries
E Management Science and Operations Research
H Honors

491. Professional Development. (1-0) Cr R F

*Credit for only one in each of the following groups of courses may be applied toward graduation: 250, 375, 373, 375; 304, 404.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates.

504. Advanced Engineering Economy (3-0) Cr 2 or 3 (3 cr for students with 2 credits prerequisite and vice versa.) F S *Prereq. 304 or 404* Advanced engineering economic analysis, engineering, financial, tax policy and other factors influencing managerial decisions involving the expenditure of capital funds

505. Capital Expenditure Programming. (3-0) Cr 3 S *Prereq 504* Determination of capital expenditure policy and budget Factors influencing the priority queue and the optimum-rationed level of expenditures Project request, consideration, revision, screening, rejection, postponement, approval, subsequent verification and feedback processes Planning and control of the capital expenditure budget and sources of funds

506. Engineering Aspects of Public Utility Administration (2-0) Cr 2 F S *Prereq 304 or 404, 407* Engineering problems arising from the regulation of service and rates, the taxation, and the operation of public utilities

507. Depreciation Estimates. (3-0) Cr 3 Alt. S., offered 1982 *Prereq. 407* Collection and analysis of retirement data Techniques required for the construction of survivor, probable life, condition percent, and accrued depreciation curves for property groups Analysis of the effect of growing, declining, and stable properties on depreciation estimates

509. Engineering Valuation Practice. (2-0) Cr 2 Alt S., offered 1983. *Prereq: 407* Application of principles of engineering valuation, including field work, preparation and pricing of inventories, valuations for utility rates, security regulations, condemnations, sales, estate settlements, and determining fixed capital costs

511. Operations-Research Concepts. (4-0) Cr 4 F *Prereq: Math 267, Stat 231* Theory and development of operations-research concepts and techniques within industrial contexts Includes simplex method, networks, dynamic programming queueing theory, inventory theory, simulation, decision analysis, integer and nonlinear programming

512. Queueing Theory and Applications. (2-0) Cr 2 S *Prereq 312 or 511* Development and use of mathematical models for the analysis of queueing systems Applications to service industries as well as industrial types of situations Steady state as well as transient systems are included

514. Advanced Material Control. (3-0) Cr 3 S *Prereq 341, 511, Stat 231 or 432* Scheduling theory for project, flow, and shop systems including synthesis of production scheduling, analysis of the job shop problem, and application of network theory and queueing theory Inventory systems, including both deterministic and stochastic lot size models, for single and multicommodity control of production materials Constrained models Computer analysis techniques

515. Management Science (4-0) Cr 4 S *Prereq 341 or 511* Management science project including proposal preparation for industry or service problems Final report on project for implementation of research results

517. Design of Industrial Engineering Systems. (2-1) Cr 3 F *Prereq 312 or 511, 404* Application of feedback and dynamic concepts to industrial systems Quantitative and simulation methods used to analyze and design effective systems for inventory, quality, scheduling etc., making efficient use of all productive resources

518. Digital Simulation Techniques. (2-3) Cr 3 F *Prereq Com S 172, Stat 231 or 432* The simulation of mathematically indeterminate management and manufacturing systems by digital computer Use of those optimization and statistical techniques that are helpful in simulation Competence is developed in GPSS with an introduction to Simscript, GASP, and GERT

527 Dynamics of Industrial Organizations. (2-2) Cr 3 S *Prereq 424* Advanced study of relevant current behavioral science research offering insight and understanding regarding the behavior of industrial organizations Applications to the development of vibrant, viable, and socially effective work organizations

531 Sequential Product and Process Control (Stat 531) See *Statistics*

533. Reliability (Stat 533) See *Statistics*

534 Mathematical Programming I. (4-0) Cr 4 F *Prereq 511, Math 267* Linear algebra, theory and computational aspects of simplex method Duality treated theoretically and as a post optimality tool Network and transportation problems Unconstrained optimization including convex and concave functions using descent methods and Quasi-Newton methods

539 Game Theory (Econ 539, Stat 539) See *Statistics*

545. Advanced Facilities Design. (3-3) Cr 4 Alt F offered 1982 *Prereq 441* Design of facilities to provide specific manufacturing services Considerations and control applications for compuer aided manufacturing operations and industrial robots Process sequence design for state-of-the-art manufacturing operations

551. Industrial Engineering Concepts. (3-0) Cr 3 F *Prereq 250 or 375, Stat 401, Math 151* Development in depth of theoretical and practical concepts of current industrial engineering practice

552. Industrial Organization Theory (2-0) Cr 2 S *Prereq 424, 551* Theories of organization with the purpose of explaining, predicting, and influencing organization behavior Requirements for design and control of industrial organizations and their components

560 Industrial Information Systems. (3-0) Cr 3 S *Prereq 209* Role of information systems in supporting industrial operations such as manufacturing, personnel, resource allocation, scheduling, and forecasting Design and usage of files. Economic and decision-process criteria in selection of hardware and software for industrial applications Human factors in design of information systems.

571 Theory and Principles of Work-Time Relationships. (2-0) Cr 2 Alt S., offered 1982 *Prereq 375, 424* Evaluation of work measurement systems considering repetitive and nonrepetitive stopwatch use, predetermined and developed standard data, and work sampling and operator log studies. Application to industrial situations Analysis of current literature

577. Human Factors. (2-2) Cr 3 F *Prereq 274, Stat 231 or 401* Physical and psychological factors affecting human performance Emphasis on applications of human factors principles, measurement techniques, and analytical methods to practical design involving safety, productivity, stress reduction, behavioral control, and individual preferences. Laboratory work includes applications to current problems in system design and operation

581. Administrative and Tax Law Aspects of Engineering. (3-0) Cr 3 F *Prereq 480* Administrative agencies, the administrative law that flows from these agencies, and its interrelationship with industry, with special emphasis on the substantive and administrative effects of taxation

582. Intellectual Property and Product Liability Aspects of Engineering. (3-0) Cr 3 S *Prereq 480* To familiarize the prospective manager with problems encountered in the areas of patents, trademarks, copyrights, and product liability

590 Special Topics. Cr 1 to 5 each time elected Independent study and work to explore recent advances and innovative approaches to industrial engineering design, practice, and research
A Valuation, Depreciation, and Engineering Economy
B Human Resource Management
C Industrial Engineering
D Regulated Industries
E Management Science and Operations Research

Courses for Graduate Students, major or minor

608. Depreciation Accountancy. (3-0) Cr 3 Alt S offered 1982 *Prereq 507* Unit and group methods of accounting for depreciation, reserve requirements adjustment of depreciation rates and reserves, classification of accounts, property accounting methods Income tax regulations

624. Advanced Human Resource Management. (2-2) Cr 3 S *Prereq 425, 527 or 552* Critical study and analysis of work design and organization structure for increase productivity Application of behavioral sciences to design of work with concern for quality of working life Legal and economic constraints included in analysis

630. Mathematical Programming II. (4-0) Cr 4 S *Prereq 534 or Stat 540* Optimality conditions for nonlinear constrained problems Primal methods penalty and barrier methods Integer programming including cutting planes, branch and bound and search enumeration plus specialized algorithms and applications

651 Production System Philosophy. (2-0) Cr 2 F *Prereq 511, 551* An in-depth examination of the philosophy, nature, and assumptions inherent in cases and problems involving systems used to produce goods and services

681. Court and Commission Practice (2-0) Cr 2 Alt F offered 1982 *Prereq 681A. 581, 608. 681B 581*
A Utility rates, property valuation, and depreciation
B Legal relations in industry

690. Advanced Topics Cr var
A Creative component for major in industrial engineering
B Creative component for major in engineering valuation

691 Seminar. Cr R F S

699 Research Cr 1 to 5
A Industrial Engineering Research
B Engineering Valuation Research

Industrial Relations

(Interdepartmental Program)

Paul M Muchinsky, Chair, Supervisory Committee

Supervisory Committee: J P Mattila, R P Manatt, C P Morrow, C E. Smith, J M Whitmer, W. F Woodman

Work is offered for the degree Master of Science with a major in industrial relations This is a multidisciplinary degree offered under a cooperative arrangement by the departments of Economics, Industrial Engineering, Political Science, Psychology, and Sociology

Graduate students in industrial relations usually receive their undergraduate background in economics, business administration, industrial engineering, political science, psychology, or sociology Admission is not restricted to students from these majors, however Students entering industrial relations ideally should have a broad background in the social sciences

The program in industrial relations is regarded as education for both professional practice and scientific inquiry Through the Industrial Relations Center and its interdisciplinary faculty, facilities and opportunity exist for research of both a fundamental and applied nature on a variety of problems concerned with the world of people at work

A student majoring in industrial relations will choose a major professor from the graduate faculty of the cooperating departments The student's program of study will be developed with the guidance of an advisory committee selected by the student and the major professor, approved by the chairman of the Industrial Relations Supervisory Committee, and appointed by the dean of the Graduate College Students may elect the thesis option (consisting of 30 semester-hour credits) or the nonthesis option (consisting of 36 semester-hour credits)

Regardless of which option is taken, all students must take the following core courses Econ 445, I E 424, and Stat 401 For students enrolled in the non-thesis option, the research component of their degree program will be satisfied via the completion of a 3 credit creative component For students enrolled in the thesis option, the research component of their degree program will be satisfied via the completion of a 6 credit thesis The balance of the program of study for students in either option will consist of electives from the recommended courses in the industrial relations curriculum A minimum of two courses must be taken in three of the five departments comprising the program, with a maximum of four courses in any one department A minimum of 12 semester credits must be taken from 500-level (or above) courses In general, the degree program in industrial relations is designed to be as flexible as possible to support the student's own professional interest Satisfactory completion of a final comprehensive oral examination is required of all students As part of their graduate education, students enrolled in the non-thesis program have the option of enrolling in an off-campus internship program

Courses appropriate for the Master of Science degree are determined by the student's advisory committee Recommended courses for graduate students majoring in industrial relations include Econ 404, 445, 446, 590B, 595; I E 421 423, 424, 527, 552, 590, 624, Pol S 420, 421, 425/525, 472, 475, 476/576, 571, 572, 573, Psych 425, 440, 450, 451, 550, 551, 590, 623, Soc 415, 420, 511, 532, 590B, 642, Stat 401, 402 See departmental listings for course descriptions and credits

Institution Management

Marjorie M McKinley, Head of Department

Professor: McKinley

Emeritus Professor: Augustine

Associate Professor: Brown

Assistant Professors: Finley Frederiksen, Hostetler, Kelley, Robson, Walsh

Instructors: Baker, Burger, Clubine, Cooper, Culver, Dudley, Greiner, Huss, Hutchcroft, Johnson

Undergraduate Study

The department offers work for the degree Bachelor of Science with curricula in foodservice management and in hotel and restaurant management, see *Home Economics, Curricula*

The curricula in institution management provide preparation for men and women interested in managerial positions in the institution foodservice and housing industry

The curriculum in foodservice management is planned to provide men and women with a general education plus professional preparation for the management of foodservices in organizations such as college and university residence halls and student unions, elementary and secondary schools, industrial plants, and office buildings The curriculum prepares students for positions as administrative dietitians, foodservice managers and foodservice directors

The curriculum in hotel and restaurant management provides, in addition to a general education, basic work to prepare men and women for supervisory and executive positions in the hotel and restaurant industry Principles of business management are presented, as well as fundamentals of foodservice and housing service

Learning experiences are provided in the quantity food production and service facility of the institution management department The food and house administration departments of the Memorial Union, university residence halls, school foodservice systems, and other approved establishments offer managerial experience to advanced students A three- or four-day field trip to organizations related to the foodservice and housing industry is offered alternate years and will be a required part of the curricula administered in institution management

An option available to students enrolled in the Foodservice Management Curriculum is the Coordinated Undergraduate Program in Dietetics that is offered jointly by the Food and Nutrition and Institution Management Departments In this program, increased emphasis is given to the application of principles in the environment of the profession, classroom learning is provided concurrently with the application of principles While completing the requirements for the B S degree, students completing this program meet the academic and experience requirements for membership in The American Dietetic Association

Graduate Study

The department offers work for the degree Master of Science with major in institution management and minor work to students taking major work in other departments

Work may be taken for the degree Doctor of Philosophy as a joint major with departments offering work for this degree in home economics, engineering, economics, education, or other related areas

The usual prerequisite to major graduate work is the completion of nine semester credits in institution management and six in food and nutrition, and fundamental preparation in accounting, chemistry, and microbiology The exact requirements will depend upon the field of work the student expects to pursue

Open to graduate students for minor credit only 434, 435, 437, 438, 450, 460, 470

Courses Primarily for Undergraduate Students

287 Introduction to Management in Selected Occupations. (2-0) Cr 2 F S Introduction to management concepts and principles with application to various occupations related to home economics Specific applications to business and industry are presented by representatives from the occupational areas

380 Quantity Food Production Management. (2-0) Cr 2 F S SS *Prereq F N 207 or 208 or 214, concurrent enrollment in 380L* Principles of management in quantity food production with emphasis on methods of preparing food in quantity, quality control, work methods, menu planning, sanitation and safety, and food cost control

380L. Quantity Food Production Management Experience (0-3) or (0-6) Cr 1 or 2 F S SS *Prereq F N 207 or 208 or 214, concurrent enrollment in 380, advance reservation with department required* Application of management in quantity food production through use of appropriate production and service methods

400 Study Tour Cr R Alt S , offered 1982 *Prereq Junior or senior institution management classification* Study tour of quantity foodservice and house administration units and related industries Offered on a satisfactory-fail basis only Fee

404 Seminar (0-2) Cr 1 S *Prereq Senior classification*

434 Food Purchasing. (2-2) Cr 3. F S *Prereq 380, 380L* Principles of food procurement and inventory management for foodservice systems Emphasis on specifications and factors affecting quality Application of menu planning principles Field trips required Fee

435. Layout and Equipment. (2-2) Cr 3 F S *Prereq Credit or classification in 380, 380L.* Food facilities planning and design, selection of equipment with emphasis on materials, construction, and specifications Field trips required Fee

436. Experience in Foodservice Management. (0-6) Cr 2 S *Prereq. Classification in 434, 435, admission to the Coordinated Undergraduate Program in Dietetics.* Supervised experience in foodservice management, with emphasis on areas related to food purchasing and layout and equipment

437 Automated Foodservice Information Systems. (2-0) Cr 2 F S *Prereq 434.* Application of computer-assisted management in foodservice organizations through the use of an educational simulation model Interpretation of computer printouts with emphasis on use of data by management in planning and controlling functions

438. Personnel Management in Institutions. (3-0) Cr 3 F S *Prereq Credit or classification in 380, 380L* Functions of management. Principles of personnel organization and management as applied to foodservice and lodging systems Principles and practices related to personnel recruitment, selection, training, employee-employer relations, and wage administration. Union and government considerations. Labor and cost control

450. Hotel and Restaurant Accounting. (2-0) Cr 2. Alt. F , offered 1981 *Prereq: 287, Acct 284.* Accounting procedures applicable to hotels, restaurants, and clubs Emphasis on hotel front office and uniform systems of accounts For students majoring in hotel and restaurant management

460. Legal Aspects of Hotel and Restaurant Management. (2-0) Cr 2 Alt F, offered 1982 *Prereq Mgmt 315* Laws relating to ownership and operation of hotels, restaurants, and similar institutions The responsibility of management and employees to guests and the public

470. Quantity Food Production and Service Methods Cr arr F S SS *Prereq A college course in principles of food preparation* Methods of producing food in quantity using institution equipment Interpretation for teaching nonsupervisory foodservice workers Designed to contribute to preparation of teachers of vocational foodservice courses Not accepted in lieu of I Mgt 380 and 380L for Iowa State institution management and food and nutrition majors

481. Foodservice Management Experience Cr 3 F S, last 5 weeks of semester *Prereq 434, 435, 437, 438, enrollment in the Coordinated Undergraduate Program in Dietetics* Analysis and interpretation of management functions Supervised experience in residence hall food services of Iowa State University

482. Food and Beverage Management Experience (2-6) Cr 3 F S *Prereq 435, 438, credit or classification in 434, advance reservation with department required* Analysis and interpretation of management functions Experience in food and beverage departments of Memorial Union, Iowa State University residence halls, or other approved establishments For students majoring in hotel and restaurant management or foodservice management

483. Lodging Management Experience (2-6) Cr 3 F *Prereq 438, 450, 460, HE St 220, advance reservation with department required* Analysis and interpretation of management functions Experience in Memorial Union, Gateway Center Motor Hotel, or other approved establishments For students majoring in hotel and restaurant management Fee

486. Comprehensive Professional Management Experience. Cr var S *Prereq 482 or 483, advance reservation with department required* Analysis and interpretation of management functions Experience in departments of Iowa State University residence halls, Memorial Union, or other approved establishments For institution management students Fee

490. Independent Study. Cr arr *Prereq Permission of department head*
A Quantity Food Production
B Organization and Management
C General
D Housing
H Honors

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

500. Short Course Cr arr

580. Quantity Food Development. (1-3) Cr 2 S *Prereq 380 and 380L, advance reservation with department required* Experimental approach to quantity food production Development of formulas within parameters of time, institution equipment, and ingredients Emphasis on sensory evaluation

585. Catering. (1-3) Cr 2 F *Prereq 380, 380L, advance reservation with department required* Management, preparation, and presentation of special foodservice functions Appreciation of historical and cultural background of U S regional and foreign foods Creative experiences with gourmet foods

590 Special Topics and Workshops. Cr arr *Prereq Permission of department head*
A Foodservice Management
B Housing Service Management
C General

Courses for Graduate Students, major or minor

601. Decision Optimization in Institution Management. (4-0) Cr 4 S *Prereq 6 semester credits in institution management including 437, college mathematics, statistics recommended, permission of department head* Application of decision theory in institution foodservice and housing systems, using quantitative methods and models to optimize decisions Use of computer as a tool for data analysis

604. Seminar. Cr arr F S SS

608. Administration Problems. Cr arr *Prereq. Permission of department head* Consideration of advanced administrative problems Case studies in foodservice and housing departments of Iowa State University, Memorial Union, and other establishments

699 Research

International Studies

K H Friederich, Chair, Advisory Committee

Advisory Committee: J F Anderson, J R Beard, J Courteau, G A Dorfman, S M Huang, K C Kruempel, M Lee, W S Osborn, P Parker, J T Scott, D M Warren, H Van de Wetering

The international studies programs are designed for students who are interested in international studies as a field of academic study and for those interested in training for employment overseas in the foreign service or other government agencies, in foreign activities of business and industry, or in technical aid and development programs in any one of five colleges Agriculture, Education, Engineering, Home Economics, or Sciences and Humanities Students in Agriculture, Education, or Sciences and Humanities enroll in another major before taking International Studies as a second major Students in Engineering and Home Economics follow the curriculum for international studies outlined by their respective colleges

Any student who wishes to enter the international studies program must register with the chairman of the international studies committee For students enrolled in Agriculture, Education, or Sciences and Humanities the chairman of the international studies committee is also responsible for cosigning a student's degree program For students in Engineering and Home Economics the student and his or her adviser are responsible for stating on the senior requirement sheet that the student is completing the program A member of the international studies committee representing the student's college (Engineering or Home Economics) must certify to the registrar that the student has completed the program requirements The registrar will then enter this fact on the student's transcript

Students who participate in international studies in the College of Agriculture and who maintain a grade-point average of 2 5 or above will be eligible for a Luther Vinton Rice Estate scholarship valued at $200 each academic year Interested students should consult their advisers

International Studies in the Colleges of Agriculture, Education, and Sciences and Humanities

Students intending to major in international studies must have a first major in another department Application for admission to the international studies program must be made to the chairman of the international studies advisory committee International studies majors must meet the following minimum requirements

I. U St 230. Seminar in International Studies. (2-0) Cr 1 F Introduction to international studies Required of all students in the international studies program
Total 1 credit

II. U St 430. Seminar in International Studies. (3-0) Cr 3 S Capstone seminar required of majors in international studies For juniors and seniors only
Total 3 credits

III. Language. A student majoring in international studies must complete two years in one foreign language If only shorter offerings of a language are available, the chairman of the international studies advisory committee may permit a student to substitute course work from Group IV below for language credits In no instance may a student be permitted to take less than one year of one foreign language None of the language credits may be counted toward the fulfillment of general education requirements Students whose first major is in foreign languages and literatures may fulfill the international studies language requirement by either taking two years of a second language or substituting 16 credits of course work from Group IV below

Students who choose Area Studies (B courses) for their international studies major should choose an appropriate area language to fulfill the international studies language requirement They should choose an area language as well for their second language if their first major is a language For example, students studying Western Europe will choose French, German, Italian, Portuguese, or Spanish as the required international studies language Students already majoring in one of the above can choose one of the others for the second language Or students studying Latin America will choose Spanish or Portuguese as the required international studies language Students already majoring in one of these languages will choose the other as the second language
Total 16 credits

IV. General Courses and Area Studies. A student must take a minimum of 18 credits selected from at least three disciplines (Section A courses) or area studies (Section B courses) with at least 6 credits in any one discipline or area Students with first majors in disciplines listed in Section A may not select courses offered by their first major department to fulfill international studies requirements
Total 18 credits

A. General Courses in International Studies.

Anthropology
Cultural Anthropology — Anthr 218 (3 cr)
The Family and Kinship in Cross-Cultural Perspective — Anthr 313 (3 cr.)
World Prehistory — Anthr 320 (3 cr)
Comparative Studies of World Cultures — Anthr 321 (3 cr)
Anthropological Perspectives of Religion — Anthr 340 (3 cr)
Language and Culture — Anthr 500 (3 cr)

Business Administration
International Business Management — Mgmt 414 (3 cr)

Economics
History of Economic Thought — Econ 312 (3 cr)
Comparative Economic Systems — Econ 306 (3 cr)
Natural Resource and Environmental Economics — Econ 380 (3 cr)
Economic Development — Econ 411 (4 cr)
International Economics — Econ 455 (3 cr)
Agrarian Reform and Economic Development — Econ 512 (3 cr)

Economic Development and Transformation of Agriculture in Developing Countries — Econ 535 (3 cr)
International Trade — Econ 555 (3 cr.)
International Finance — Econ 557 (3 cr)
Agriculture Resource and Income Problems — Econ 561 (3 cr)
Agriculture and Food Policies and Programs — Econ 562 (3 cr.)

Geography (Earth Sciences)
Principles of Geography — Geog 100 (3 cr)
Cultural Geography — Geog 324 (2 cr)
Cultural Geography Asia, Africa — Geog 325 (2 cr)*
Man and Land in Anglo-America — Geog 326 (2 cr)*
Europe — Geog 328
Summer Field Study — Geog 495 (4 to 6 cr)

History
Introduction to Western Civilization — Hist 201, 202 (3 cr each)
Introduction to the History of Science — Hist 280, 281 (3 cr each)
Modern Military History — Hist 390 (3 cr)
Introduction to the History of Technology and Engineering — Hist 284, 285 (3 cr each)
International Business History — Hist 376 (3 cr)
History of U S Foreign Policy — Hist 467, 468 (3 cr each)
History of Agricultural Sciences and Technology — Hist 480 (3 cr)

*May also be taken under appropriate geographical area studies.

Journalism and Mass Communication
International Communication and the Foreign Press — Jl MC 440 (3 cr)
Mass Communiation in Developing Nations — JL MC 545 (3 cr)

Political Science
Introduction to Comparative Government and Politics — Pol S 241 (3 cr)
Introduction to International Politics — Pol S 251 (3 cr)
Politics of Developing Areas — Pol S 340 (3 cr)
U S Foreign Policy — Pol S 358 (3 cr)
International Law — Pol S 422 (3 cr)
The Military and Politics — Pol S 448 (3 cr)
Comparative Foreign Policy — Pol S 452 (3 cr)
International Organizations — Pol S 453 (3 cr)
Development Administration — Pol S 478 (3 cr)
World Food and Development Assistance Politics — Pol S 481 (3 cr.)
Single-Party States — Pol S 543 (3 cr)
Political Leadership and Elites — Pol S 547 (3 cr)
Comparative Political Behavior — Pol S 549 (3 cr)
International Relations Theory — Pol S 559 (3 cr)
Special Topics Comparative Government — Pol S 590D (2-5 cr)
Special Topics International Relations — Pol S 590E (2-5 cr.)

Religious Studies
Introduction to World Religions — Relig 250 (3 or 4 cr)

Sciences and Humanities
Cross-cultural Explorations Introduction to Third World Cultures — S-H 230 (3 cr)

Sociology
Sociology of Language (Sociolinguistics) — Soc 405 (3 cr)
Societal Change and Development — Soc 411 (3 cr)
Adoption and Diffusion of Innovations — Soc 415 (3 cr)

University Studies
Introduction to World Food Problems — U St 241 (2 cr)
Technology International, Social, and Human Problems — TSC or U St 341 (3 cr)
Seminar in Technology and Social Change The International Dimension — TSC or U St 440 (1 cr)
Independent Study International — U St 490 (cr var)
Independent Study Technology and Social Change — TSC or U St 490F (cr var)
Technology and Social Change in Foreign Cultures — TSC or U St 541 (3 cr)
World Food Issues — TSC or U St 542 (3 cr)
Special Topics Technology and Social Change — TSC or U St 590F (cr var)
Seminar in Technology and Social Change — TSC or U St 640 (1-3 cr)
Foreign Study — U St 437 (cr var)

B. Area Studies

Africa and the Middle East
Introduction to African History — Hist 211 (3 cr)
Archaeology of Africa — Anthr 334 (3 cr)
Peoples and Cultures of the Old World Africa — Anthr 324 (3 cr)
Peoples and Cultures of the Old World Near East — Anthr 324 (3 cr)
Introduction to African Politics — Pol S 347 (3 cr)
Society and Politics of Israel — Pol S 348 (3 cr)
Development in African Politics — Pol S 447 (3 cr)
Recent Francophone Literature of Africa and the Caribbean — Frnch 210 (3 cr)

Asia
Peoples and Cultures of the Old World Asia — Anthr 324 (3 cr)
Peoples and Cultures of the Old World Oceania — Anthr 324 (3 cr)
Introduction to Chinese Civilization — Hist 207 (3 cr)
Introduction to Japanese Civilization — Hist 208 (3 cr)
History of Modern China — Hist 336, 337 (3 cr each)
Modern Japanese History — Hist 436 (3 cr)
Ways of Enlightenment Hinduism & Buddhism
Politics of Japan — Pol S 341 (3 cr)
Politics of the People's Republic of China — Pol S 342 (3 cr)
Asia in World Politics — Pol S 451 (3 cr)

Latin America
Contemporary Latin-American Cultures — Anthr 323 (3 cr)
History of Latin America — Hist 340, 341 (3 cr each)
Survey of Culture and Literature of Hispanic World — Span 321, 322 (3 cr each)
Latin American Government and Politics — Pol S 343 (3 cr)
The U S and Latin Amenca — Pol S 443 (3 cr)
History of Mexico — Hist 441 (3 cr)
Asia in Politics — Pol S 451 (3 cr)
Luso-Brazilian Civilization and Culture — Port 321, 322 (4 cr. each)
Trends and Major Figures in Literature of Spanish Amenca from Colonial Times to Independence — Span 454 (3 cr)
Trends and Major Figures in Literature of Spanish Amenca from Post-Independence to the Present — Span 455 (3 cr)

Russia and Eastern Europe
Russian Civilization — Rus 321, 322 (3 cr each)
History of Russia — Hist 421, 422 (3 cr. each)
Modern East Central Europe — Hist 426 (3 cr.)
Government and Politics of the Soviet Union — Pol S 444 (3 cr.)
Soviet Foreign Policy — Pol S 457 (3 cr)

Western Europe
Peoples and Cultures of the Old World Europe — Anthr 324 (3 cr)
Archaeology of Europe and the Near East — Anthr 426 (3 cr)
French Civilization — Frnch 321, 322 (3 cr each)
German Civilization — Ger 321, 322 (3 cr each)
Spanish and Ibero-American Civilization — Span 321, 322 (3 cr each)
History of Medieval Western Europe — Hist 405, 406 (3 cr each)
Contemporary Europe — Hist 411, 412 (3 cr each)
European Society in the Age of Enlightenment — Hist 416 (3 cr)
European Society and the Industrial Revolution — Hist 417 (3 cr)
French History — Hist 419 (3 cr)
History of Modern Germany — Hist 424 (3 cr)
Medieval England — Hist 427, 428 (3 cr each)
History of the Family in the Western World — Hist 384 (3 cr)
Modern England — Hist 430, 431 (3 cr each)
Science and Religion in Hist 323 (3 cr)
History of England — Hist 325, 326 (3 cr each)
Medieval and Renaissance Italy — Hist 407 (3 cr)
Europe, 1500-1648 — Hist 408 (3 cr)
19th Century Europe — Hist 410 (3 cr)
European Intellectual History — Hist 414 (3 cr.)
World Economic History — Hist 381 (3 cr)
U S Economic History — Hist 382 (3 cr)
British Politics — Pol S 345 (3 cr)
Governments of Western Europe — Pol S 346 (3 cr)
Europe — Geog 328 (3 cr)
Western Religious Thought — Relig 365 (3 cr)
Contemporary Western Religious Thought — Relig 465 (4 cr)
Overall Total 38 credits

International Studies in the College of Agriculture

Agriculture students are given two alternative programs for securing a secondary major emphasizing the international dimension. They can select the course of study described above or they can choose to follow the alternate program, International Agriculture. For information on the alternate program, see Index, *International Agriculture*

International Studies in the College of Engineering

Students in engineering participating in the International Studies Program remain in their professional curriculum and may use their electives for part of the International Studies Program requirements. An International Studies Program in Engineering shall have a minimum of 30 credits including University Studies 430 and a minimum of eight credits of foreign language. Interested engineering students should consult with their engineering advisers and the engineering faculty member of the International Studies Advisory Committee early in their residence at the University

International Studies in the College of Home Economics

A major in international studies is designed to provide students with a background for participation in government or agency programs, as well as to provide an opportunity to become oriented to national and international affairs as part of the responsibility of citizenship in its broadest sense

Students in home economics with a major in international studies follow a curriculum that includes emphasis in social sciences — history, political science, economics, sociology, anthropology, psychology, and languages — in addition to home economics

See *Home Economics* for the specific program Interested students in home economics should consult Julia F Anderson for further details

SPAN

Student Project for Amity among Nations (SPAN) is a program of carefully supervised foreign study Participants spend one academic year promoting SPAN, planning research projects, and gaining background on the country to be visited In most instances one year's study of an appropriate language is also required as part of the preparation year. Field studies require approximately eight weeks abroad during the summer following the year of preparation During the academic year after the summer abroad participants prepare a report on their investigation and devote further effort to the promotion of SPAN.

Total credits offered are 8 4 for preparation and the field study, 4 for the report and SPAN activity Grades for the first 4 credits are determined by the group adviser, for the final 4 credits the grades are determined jointly by the project counselor and the group adviser Classification may be in university studies courses or in appropriate formal or special problems courses Language credits are additional and grades are given by the language instructor

Initiation of a SPAN project begins when at least 15 students request the chairman of the international studies advisory committee to (1) approve a country of the students' choice, (2) search for a faculty adviser, and (3) make arrangements for appropriate language instruction, if necessary

Requests to initiate a SPAN project must be received at least 3 regular semesters (excluding summer sessions) before the summer in which students intend to go abroad

Journalism and Mass Communication

Robert S Kahan, Chair of Department

Professors: Blinn, Bratton, Crom, Disney, Hamilton, Hvistendahl, Kahan, Kunerth, Marvin, Pollard, Shelley, Yarbrough

Emeritus Professors: Fox, Schwartz

Associate Professors: Abbott, Bailey, Boyd, Emmerson, Friederich, Gillette, Groth, Johnson, Lendt, Nelson, Scherer

Assistant Professors: Beell, Cooper, Fassel, Floren, Hart, Kielbowicz, Saccopoulos, Wechsler

Instructors: Edmonds, Liu, Pnor

Undergraduate Study

The department offers work for the degrees Bachelor of Science and Bachelor of Arts with majors in general journalism, agricultural journalism, engineering journalism, home economics journalism, and science journalism The department has full accreditation from the American Council on Education in Journalism with specific accreditation in news-editorial, broadcast news and advertising Specialized coursework also is available to students interested in newspapers, magazines, public information and public relations, media management, international communication, visual communication and the teaching of journalism Specific coursework is designed with the aid of the student's academic adviser in journalism and varies according to the student's background, experience, and career goals

Students enroll in one of the following colleges
College of Sciences and Humanities (general journalism and science journalism)
College of Agriculture (agricultural journalism)
College of Home Economics (home economics journalism)
College of Engineering (engineering operations with special program in engineering journalism)

All majors take a minimum of 30 credits of journalism courses, including a common core of courses and 2 credits of 499, Professional Media Internship National journalism accreditation standards recommend that the number of journalism credits in the degree program be limited to approximately one quarter of total credits taken See your adviser for further information

Cr.	Degree Requirements
I.	Basic Core Courses
2	Introduction to Mass Communication — JI MC 101
8	Basic Reporting, Writing, Editing — JI MC 201, 202, 203
3	Law of Communication — JI MC 430
1	Professional Seminar — JI MC 491
2	Professional Media Internship — JI MC 499
16	

II. Skills Courses

Students must select a minimum of 9 credits of 300-level courses according to their area of specialization One of the courses selected must come from the following group JI MC 345, 352, 360, 361, 370 The remainder may be selected from the above courses or from among other 300-level journalism courses

III. Advanced Courses

Students must select a minimum of 5 credits of 400-level courses in addition to those required in the basic core One of these 400-level courses must come from the following group JI MC 410, 431, 462 The remainder may be taken from the above courses or from among other 400-level courses except 490, 491 or 499 Students, in consultation with their advisers, should select courses which complement their area of specialization

A minor, area of concentration, or second major in subject matter outside journalism also is required See your adviser

Students majoring in other fields who elect a minor or area of concentration in journalism are invited to consult with journalism staff members for a recommended sequence of courses tailored to fit their particular needs and goals

Graduate Study

The department offers the degree of master of science with major in journalism and mass communication, and minor work to students taking major work in other departments

For major work, a student must have a bachelor's degree in journalism or in a subject matter area which he or she wishes to combine professionally with advanced training in journalism and mass communication

Admission of international students is limited to applicants with two types of backgrounds 1) those engaged in communication or development in such fields as agriculture, home economics, and natural resources in their own country and whose employment indicates a need for specialized training, 2) those who can document at least two years of professional journalism or the teaching of journalism and who wish to improve their professional capability

Open to graduate students for minor credit only 410, 425, 430, 431, 438, 440, 450, 462, 464

Courses Primarily for Undergraduate Students

101. Introduction to Mass Communication. (2-0) Cr 2 F S SS Communication models and their application to the mass media, the mass communication process, organization, characteristics and responsibilities of the mass media, media-related professional operations For freshmen, sophomores only

201, 202, 203 Basic Reporting, Writing, Editing 201 (2-6) Cr 4 F S, 202 (1-3) Cr 2 F S, 203 (1-6) Cr 2 F S *Prereq 201 English 105, some typing proficiency, satisfactory performance on a standard English usage test administered by the department. 202 201, 203 concurrent registration in 202* News judgment and observation, organizing, writing and editing for the mass media Sequence moves from simple information gathering, analysis, and writing techniques to polling, investigative reporting, and interpretive writing 203 consists of writing for print or broadcast media

225. Publicity and Public Relations (2-0) Cr 2 F S SS *Prereq Engl 105* Communication fundamentals, gathering material for mass media and sharpening writing skills by preparing stories for publication, operation, problems, and philosophies of media using the media for publicity, public information, and public relations purposes Not available to journalism majors

312 Fundamentals of Photography (2-3) Cr 3 F S SS Introduction to visual communications Camera and darkroom techniques Evaluation of photographs in terms of content, lighting, and pictorial composition Fee

317 Communications Photography (2-3) Cr 3 F *Prereq 201* Introduction to use of still photography as a communications tool Development of photographic skills in reporting, emphasis on photographic skills in exposure, development and printing for various reproduction processes Fee

318 Advanced Photography (2-3) Cr 3 S *Prereq 312 or 317* Offers choice of fine arts, scientific, or documentary approach to development of advanced photographic perception and technique Combines tutorial sessions with discussion groups to explore trends in contemporary photography and to offer forum for critical analysis of student work Fee

319 Motion Picture Technique (Sp 319) (1-3) Cr 2 F S Basic techniques in shooting, editing and presenting motion pictures as a means of communication, with special stress on 16mm format Fee

320. Color Slide Photography (3-0) Cr 3 F Use of color slide material to develop technical and aesthetic abilities on the intermediate photographic level Multi-screen, multi-media lectures Introduction to technique of slide-tape presentation No lab

322 **Multi-Image Slide-Tape Production.** (0-6) Cr 3 S *Prereq 312 or 317 or 320* Production of professional-level slide-tape presentations Intensive hands-on work with slide editing, slide sequencing, scripting and storyboarding. Development of mixed sound tracks, use of dissolve, programming and cueing devices Production of single and multiple-screen presentations

324 **Photo Editing.** (0-4) Cr 2 F *Prereq 317* Selection and layout of photographs for both newspaper and magazine formats Development of criteria for selecting photographs to serve a communications function

325. **Advertising Principles.** (3-0) Cr 3 F S SS Historical, social, economic, and legal aspects Evaluation of advertising research, media, strategy, and appeals of advertising Creation of broadcast and print advertising studied Not recommended for freshmen

342 **Layout and Design of Publications.** (2-2) Cr 3 F S SS *Prereq Sophomore standing* Principles and practice of layout and design Study of basic and advanced design, copyfitting, type, printing processes, art/photo editing, mechanical preparation, binding, imposition and paper Projects in the design of magazines, newspapers, brochures, and other printed materials

345. **Advertising Communication.** (2-6) Cr 4 F S SS *Prereq 325, 342* Advertising strategy, audience selection, positioning, research, visualization and copywriting Legal, ethical, budget and managerial considerations Laboratory preparation of advertising for both print and broadcast media

352 **Radio News Reporting.** (2-3) Cr 3 F *Prereq 203* News gathering, writing, editing, preparation of broadcast news and public affairs programs Fee for field trips

354 **Television News Reporting.** (2-4) Cr 3 S *Prereq 319, 352* Television news techniques, reporting with motion picture and electronic news gathering equipment, script writing, editing methods Laboratory experience in professional television newsroom

356. **Advanced Broadcast News Reporting.** (2-4) Cr 3 F SS *Prereq 354* Advanced reporting, writing and performance in professional television newsroom, broadcast documentaries

360. **Depth Reporting and Writing.** (2-3) Cr 3 F *Prereq 203* Developing comprehensive news features and magazine articles on current issues and concerns Majors may not apply both 360 and Engl 303 toward graduation

361 **Public Affairs and Investigative Reporting.** (2-3) Cr 3 S *Prereq 203* Reporting on government, business, and other institutions, identification of and access to public records, investigative reporting techniques, developing major stories on public agencies and issues Broadcast option possible

370 **Print Media Editing and Production** (2-6) Cr 4 F S *Prereq 203* Editing and editorial decision-making in planning and staffing information gathering and processing systems Copy and photo-art preparation, headline and title writing; introduction to layout and design of brochures, magazines, and newspapers, printing processes, production methods, and costs

410 **Mass Communication.** (3-0) Cr 3 F S *Prereq 6 credits in social science.* Role of mass media, the scientific process, methods of measuring, evaluating and reporting media effects

425 **Impact of Communication Technology on People and Societies.** (2-0) Cr 2 F *Prereq Permission of instructor* Seminar on present and potential effects of increasingly sophisticated modes of mass communication on people, institutions, and societies

430 **Law of Communication.** (3-0) Cr 3 F S SS *Prereq 6 credits in social science* Defamation, privacy, sedition, obscenity, contempt, lottery, copyright, postal laws the Federal Communications Act, laws affecting advertising, legal publication, and other business activities of the press

431 **Background of American Journalism.** (3-0) Cr 3 F S Role of the press in shaping the social, economic, and political history of America, impact of change in these areas on the development, traditions, and philosophies of the press

438 **Advertising and Public Relations Campaigns.** (3-0) Cr 3 S *Prereq 345* Development of advertising and public relations campaigns for business and social institutions by projects involving budgeting media selection, market analysis, campaign strategy and practices in preparing the nucleus of a plans book

439 **Documentary in Film and Television.** (Sp 439) See *Speech, Telecommunicative Arts*

440. **International Communication and the Foreign Press.** (3-0) Cr 3 F *Prereq 6 credits in social science* World communication systems, newsgathering and dissemination agencies, the role of foreign correspondents, factors determining flow and volume of world news Comparative analysis of mass media International political communication, role of U S. media in world affairs

450. **Institutional Public Relations.** (3-0) Cr 3 F S SS *Prereq 6 credits in social science* Public relations in business and other organizations, functions, process, and management, attitudes, public opinion and persuasion, tools of the public relations communicator, management of change in contemporary society

462. **Press Freedom, Responsibility, Ethics.** (3-0) Cr 3 F S SS *Prereq Permission of instructor* Press ethics and performance; functions of the press in relation to the executive, judicial and legislative branches of government, agencies of press criticism, right to know versus right to privacy

464. **Journalism and Literature** (3-0) Cr 3 F *Prereq Permission of instructor* Writing as art as practiced by Twain, Hemingway, Crane, Dreiser, Whitman, Mencken, others, inquiry into the problems of the "New Journalism" as practiced by contemporary journalists

470. **Media Management.** (3-0) Cr 3 Alt S, offered 1982 *Prereq 201, Econ 201* Decision-making functions of media. Basic media market analysis, media organization and management, circulation and audience development, technological developments affecting management decisions, electronic news and editing systems, media relationships with labor, affiliations with national media organizations, and regulatory agencies which affect media operation

480. **Teaching High School Journalism** (3-0) Cr 3 S *Prereq Admission to teacher education, 370, Sec Ed 426* Teaching high school journalism, advising high school publications, and teaching mass media

490. **Independent Study in Communication** Cr arr *Prereq Permission of instructor, completion of a proposal form* Students may elect to study problems associated with a medium, a professional specialization, a philosophical or practical concern, a reportorial method or writing technique, or a special topic in their field

I Media Studies
- A Book Publishing
- B Broadcasting
- C Magazine
- D Newspaper

II. Professional Specialization
- E Advertising
- F Communication Technology
- G Education
- I Media Management
- K Public Information/Public Relations
- L Visual Communication

III Problems and Methods
- M Contemporary Issues
- N Ethics and Responsibility
- P International Communication
- Q History and Literature
- R Law
- S Public Opinion
- T Research Methods

IV Technique and Style
- U Documentary
- V Persuasion and Criticism
- W Public Affairs Reporting

491 **Professional Seminar** (2-0) 8 weeks Cr 1 F S *Prereq Advanced classification*

499 **Professional Media Internship.** Cr 2 *Prereq Advanced classification* Required of journalism majors Offered on a satisfactory-fail basis only

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

501. **Theories of Mass Communication** (3-3) Cr 4 F *Prereq 6 credits in social science* Examination of major areas of research activity and theoretic development related to organization, functions, and effects of mass communication

502. **Mass Communication Research.** (3-3) Cr 4 S *Prereq 501* Applied research in broadcast and print media. survey research, audience and readership studies, readability, content analysis, media performance, experimental research, and sampling, theoretical research in systems theory, uses and gratifications theory, and the diffusion process as applied to the mass media

515. **Strategies of Communication.** (1-2) Cr. 2. (3-0) S SS *Prereq 6 credits in social science.* The process of developing professional communication and persuasion strategies, with emphasis on problem definition, behavioral specification of objectives, situation analysis, strategy formulation, and justification through application of communication theories and research results

517. **Visual Communication.** (2-0) Cr 2 S *Prereq. Permission of instructor* Exploration of aesthetic and social concepts in documentary still photography Review of historical trends with emphasis on still photography as both an art form and as a means of social documentation

526. **Journalistic methods.** (1-3) Cr 2. F *Prereq. Permission of instructor* Reporting, writing and editing for the mass media Designed for advanced students who have little or no background in journalism Required of majors with minimum professional experience, *credits for majors will be in addition to the 30 required for graduation*

527. **Specialized Reporting.** (1-4) Cr 2 S *Prereq 526.* Reporting, writing, and editing for the communicator who mediates between scholar, scientist, and various publics

528. **Advanced Journalistic Methods.** (2-4) Cr. 4 F *Prereq 501, 527* Strategic planning and preparation of major communication programs including problem and audience analysis and the reporting, writing, editing and preparation of materials for appropriate media. Required of all majors except those in mass communication emphasis

530. **The Press and Society: Interrelationships.** (3-0) Cr 3 *Prereq 6 credits in social science* The press and its functions in a democratic society; conflicts between the press and social institutions, legal, social and political controls on the press, First Amendment theory

545. **Mass Communication in Developing Nations.** (3-0) Cr 3 S *Prereq. 6 credits in social science.* Analysis of distribution of mass media in developing nations. Evaluation and comparison of traditional and transitional systems of communication in Africa, Asia and Latin America Analysis of worldwide information flow Role of communication in national development

550 **Television and Society.** (2-0) Cr 2 S SS *Prereq Graduate classification, permission of instructor* Examination of television's role in and impact on American society against historical background of its development and regulation Contemporary evaluations of the medium's performance discussed in seminar format Major paper required

590 **Special topics.** Cr arr *Prereq Permission of instructor*
- A Broadcasting
- B Visual/Pictorial
- C Advertising
- D Media Management
- E Law
- F History
- G International
- I Audiences and Effects
- K Technology
- L Agricultural Journalism
- M Journalism Education
- N Home Economics Journalism
- O Public Relations

591. **Professional Media Work.** (0-6) Cr 2. F S.SS. *Prereq. 526* Supervised internship experience on selected media *Credits are to be applied in excess of the number required for graduation* Required of graduate students with minimal professional experience

650. **Seminars in Journalism Communication.** Cr 2-3 each Offered as demand warrants from following topic list
- A Broadcasting
- B Visual/Pictorial
- C Television Responsibility and Performance
- D Media Management
- E Communications Law
- F Communications History
- G International Communications
- H Society and Mass Communication
- I Audiences and Effects
- M Teaching Journalism and Mass Communication
- N Layout and Design of Publications
- O Book Production
- P Contemporary Problems
- Q Computer Applications
- R Visual Communication Research

699. **Research.**

Landscape Architecture

Albert J Rutledge, Chair of Department

Professors: Dyas, Harvey, Lane, Roberts, Rutledge, Sinatra

Emeritus Professor: Thomas A Barton

Associate Professors: Boon, Hightshoe

Assistant Professors: Anderson, Crandell, Grundmann, Maechling, Olson

Undergraduate Study

For undergraduate curriculum in landscape architecture leading to the degree Bachelor of Landscape Architecture, see *College of Design, Curricula*

Landscape architecture is a profession concerned with the quality of land use It includes analysis of environmental factors and recommendations for preservation, and with other professions, the design, construction and maintenance of developed land areas. Among the types of land development normally included in professional practice are park and recreation areas, school grounds, institutional grounds, industrial sites, commercial sites, land subdivisions, and residential properties The scale or scope of such projects varies from broad regional landscape analysis and planning to detailed design

The curriculum, accredited by the American Society of Landscape Architects, provides the subject with an education which, combined with experience, is necessary for professional registration

The curriculum is composed of a two-year preprofessional program and a three-year professional program

Admission of students into the professional program is subject to the approval of a faculty committee at the completion of the preprofessional program Scholastic performance, aptitude, and personal development are the qualifications considered Preprofessional credits must average at least 2 30 on a 4 0 marking system and this minimum must be maintained through graduation

Graduate Study

The department offers work for the degree Master of Landscape Architecture with major in landscape architecture Minor work is offered to students taking major work in other departmentrs

The degree Master of Landscape Architecture is granted upon the completion of two years of graduate study with a minimum of 40 credits in residence at Iowa State University Satisfactory completion of L A 500, 541, 542, 643, 644, or their equivalents, and the acceptance of a thesis or a terminal project are required for the M L A degree

Students desiring to major in landscape architecture should present credits substantially equivalent to those secured by undergraduate students in the curriculum in landscape architecture at this institution Students who cannot qualify with equivalent credits may be required to complete an additional year of study The department also participates in the interdepartmental minor in Housing (See *Index*)

Open to graduate students for minor credit only. 361, 462, 463.

Courses Primarily for Undergraduate Students

241. Basic Landscape Architecture Design and Graphics. (1-9) Cr 4 F *Prereq 6 credits of graphics* Design process, site analysis, programming, concept formation, form making, and communication presented in problems dealing with design of outdoor space Various graphic and rendering techniques used in the development and communication of landscape architectural projects, reports, and programs Fee

251. Fundamentals of Site Grading and Construction. (1-9) Cr 4 S *Prereq. 241* Introduction to grading sites for residential and recreation use Preparation of grading plans and construction drawings Computation of earth volumes and land areas Design considerations for walks, ramps, stairs, drives, low walls, terraces, and storm water drainage systems Fee

271. Landscape Architecture History. (3-0) Cr 3 S The development of landscape architecture from antiquity to modern times, with its relation to and influences of allied arts and professions Lectures, readings, abstracts, reports

301 Planning Recreation Systems. (2-0) Cr 2 S Introduction to planning of sites for recreation Techniques used to plan urban park systems Field trips Fee

309. Field Travel. Cr 1 each time taken F S *Prereq Permission of instructor* Observation of the professional practice of landscape architecture in urban, rural, and natural areas Offered on a satisfactory-fail basis only Fee

321 Plant Materials and Planting Design I (1-9) Cr 4 F *Prereq Biol 109 or Bot 207* Introduction to native grasses, forbs, trees, shrubs, and vines of the midwest used in landscape design Emphasis on visual characteristics, cultural requirements, and ecological relationships Planting design principles and techniques Field trips Fee

322. Plant Materials and Planting Design II. (1-9) Cr 4 S *Prereq 321* Trees, shrubs, vines and herbaceous materials used in landscape design Emphasis on function, visual, cultural and ecological aspects of introduced species and horticultural varieties hardy in the midwest Planting design principles and techniques Field trips Fee

335 Site and Landscape Design Studio (0-12) Cr 4 SS *Prereq 251 322, 361* Site and planting design, the development of a process and approach to handling site and landscape design problems Intermediate and advanced levels of site and landscape design Field trips Fee

342. Intermediate Landscape Architecture Design (1-9) Cr 4 S *Prereq 251, 322, 361* Practice in using social science information and communication techniques to understand human needs Use of the design process to apply information about human needs to comprehensive site design solutions Field trips Fee

361 Landscape Inventory and Analysis. (2-6) Cr 4 F *Prereq 241* Basic land use and natural resource data used in the landscape planning and design process Review of data characteristics, landscape analysis techniques, and applications to site level and regional level problems Identifying opportunities and limitation of landscape characteristics in planning and design for human use Fee

443. Advanced Site Planning and Planting Design. (1-9) Cr 4 S *Prereq 342* Solving complex site design problems with emphasis on interrelationships of utility, pedestrian and vehicular systems, building relationships, and the effect of natural systems Integration of site design and planting design, preparation of a complete planting document with plans, schedules, details, and specifications Field trips Fee

444. Landscape Architecture Seminar. (2-0) Cr 2 F *Prereq 443* Topics of concern to the professional landscape architect Resume preparation, interviewing, employment, professional ethics, licensing requirements, continuing education.

452. Site Construction and Structures. (1-9) Cr 4 F *Prereq 342, Con E 241.* Solving complex site construction problems including storm drainage, retaining walls, lighting, water and irrigation systems, mechanical and electrical systems, paving systems, wood technology, and structural theory Detailing and preparation of contract drawings and specifications. Field trips. Fee

453. Professional Procedures (2-6) Cr 4 S *Prereq 452* Preparation of proposals, contracts, other documents, and specifications for design services Field trips. Fee

462. Landscape Evaluation. (1-9) Cr 4 S *Prereq 342 361* Inventory, classification, and development of management objectives for visual components of landscapes Techniques for interpreting and communicating this information Legal and procedural precedents Field trips Fee

463. Comprehensive Landscape Planning (1-9) Cr 4 F *Prereq 443, 462* Physical design and arrangement of various land uses at regional and community scales Design methodology and concepts communicated through graphic, written, and oral reports Application of procedures which systematically analyze physical design impacts and define actions which could minimize the impacts Field trips Fee

472. Landscape Architecture History and Preservation. (3-0) Cr. 3. F. *Prereq. 271, 342* Theories, concepts, and effects of design influence upon physical environment Research methods in preservation and restoration of the historic landscape Lectures, readings, abstracts, reports

490. Independent Study. Cr 1 to 4 F S SS *Prereq Permission of instructor* Investigation of an approved topic of special interest to the student Election of course and topic must be approved in advance Offered on a satisfactory-fail basis only
A Landscape Design
B Planting Design
C Construction
D History
E Landscape Planning
F Urban Design
G Graphics
H Honors
I Interdisciplinary Studies

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

500 Seminar (0-9) Cr 3 F *Prereq 463*

541 Studio Workshop I (0-9) Cr 3 F *Prereq 463*

542. Studio Workshop II. (0-9) Cr 3 S *Prereq 541*

590. Special Topics Cr 1 to 4 F S SS *Prereq Permission of instructor*
A Landscape Design
B Planting Design
C Construction
D History
E Landscape Planning
F Urban Design
G Interdisciplinary Studies

Courses for Graduate Students, major or minor

643. Studio Workshop III. (0-9) Cr 3 F *Prereq 542*

644. Studio Workshop IV. (0-9) Cr 3 S *Prereq 643*

650 Terminal Project. Cr Var F S SS *Prereq Permission of major professor* Comprehensive study and original development of a project selected by the student and approved by the department Completed project must be submitted to and approved by a graduate faculty committee as evidence of mastery of the principles of landscape architecture

699. Research. Cr Var F S SS

Library

Warren B Kuhn, Head of Department

Professors: Galejs, Kuhn, McNee, Yates

Associate Professors: Cook, Gapen, Gherman, Lee, McKee, Morris, Orr, Pady, Peterson, Sage, Van De Voorde, von Godany

Assistant Professors: Bond, Fishbein, Foreman, Fouty, Fryer, Hobert, Jacobson, Kirk, Kraft, Lineweaver, Madison, Mathews, Mischo, Noland, Paff, Perdue, M Roughton, Shonrock, Sickles, Wendell

Instructors: Coniglio, Duke, Kline, Klaas, Osmus, Richardson, Rod, K Roughton, Tallman

Undergraduate Study

The Library offers instruction to increase facility in the independent use of libraries and books

Graduate Study

The Library offers a series of non-credit seminars to assist graduate students in the effective use of the Library's research resources The seminars cover general materials as well as more specialized ones in the broad areas of the biological and agricultural sciences, the engineering and physical sciences, and the humanities and social sciences For information and registration consult the Library Reference Department Offered F S SS

Courses Primarily for Undergraduate Students

160 Library Instruction. (1-0) Cr 5 8 weeks F S *Prereq for students whose native language is not English Completion of English 100 requirement* Use of libraries and books, including services offered and use of indexing services and reference materials Offered on a satisfactory-fail basis only To be taken during the freshman year or for transfer students during their first semester at Iowa State University

Linguistics

Supervisory Committee: Clyde Thogmartin, Chair, S Gonzo, M. Lee, J. D. Lempers, M Mason, W R Underhill, D M Warren

Undergraduate Study

The Linguistics Program is a cross-disciplinary program in the College of Sciences and Humanities designed to meet the needs of students interested in various aspects of language — its structure, history, varieties, meanings, and uses Courses offered in eight different departments provide a multi-disciplinary approach to the study of human language

Courses in linguistics serve as background for students interested in any career that involves working with language, such as anthropology, computer word processing, foreign language teaching, teaching English both as a first and as a second language, psychology, sociology, speech-language pathology and audiology

In the College of Sciences and Humanities, courses in linguistics can be applied as electives or as part of the group requirements They may also be used in a minor (see below), as one of the three component areas in a distributed studies major, or in an individual major

Minors in linguistics are usually individually tailored to the interests of the student, who consults with the chairman or one of the members of the Linguistics Program Advisory Committee All minors must have a minimum of 15 credits in linguistics, of which 6 must be in courses numbered over 300 All programs must include English 219 or Anthropology 221, and either Speech 271 or Foreign Languages and Literatures 491

For information about using linguistics courses in a distributed studies major or an individual major, see *Sciences and Humanities Cross-Disciplinary Studies*

Graduate Study

The following courses may be used in graduate programs with the approval of the student's program of study committee Engl 420, 495B, F Lng 491, 492, Soc 405, and Sp 371

Primary Courses (Departmental)

Anthro 221. Linguistic Anthropology. See *Anthropology*

Anthro 490D. Independent Study: Linguistic Anthropology. See *Anthropology*

Anthro 500. Language and Culture See *Anthropology*

Anthro 590. Special Topics. See *Anthropology*

Anthro 598K. Advanced Topics See *Anthropology*

C D 631 Cognitive and Language Development in Children. See *Child Development*

Engl 219 Introduction to English Linguistics See *English*

Engl 220 Applied English Grammar See *English*

Engl 419 English Syntax. See *English*

Engl 420 History and Dialects of the English Language See *English*

Engl 490B. Independent Study Linguistics, Semantics. See *English*

Engl 495 Teaching English to Speakers of Other Languages Methods and Materials. See *English*

Engl 511 Introduction to General Linguistics See *English*

Engl 512 Historical Linguistics and Language Classification See *English*

Engl 514. Regional and Social Dialects of American English See *English*

Engl 515 Phonology See *English*

Engl 516. English Syntax. See *English*

Engl 517. Theoretical Foundations for Teaching English to Speakers of Other Languages See *English*

Engl 589B. Seminar: Linguistics. See *English*

Engl 590B. Special Topics: Linguistics See *English*

F Lng 491 Linguistics for Foreign Languages Teaching See *Foreign Languages and Literatures*

F Lng 492. History of the Romance Languages. See *Foreign Languages and Literatures*

Phil 207. Introduction to Symbolic Logic. See *Philosophy*

Psych 413. Psychology of Language. See *Psychology*

Soc 405. Sociology of Language. See *Sociology*

Soc 546. Applied Sociolinguistics: Lingulstic Problems of Developing Nations. See *Sociology*

Sp 225. Nonverbal Communication. See *Speech*

Sp 270. Speech and Hearing Science See *Speech*

Sp 271 Phonetics. See *Speech*

Sp 275. Introduction to Communication Disorders. See *Speech*

Sp 305. Semantics. See *Speech*

Sp 371 Language Development See *Speech*

Materials Science and Engineering

David R Wilder, Chair of Department

Professors: Berard, Carlson, Chen, Dodd, Gschneidner, Hunter, Kayser, Larsen, McGee, Patterson, Peterson, Scott, Smith, Trivedi, Verhoeven, Wechsler, Wilder

Emeritus Professors: Chiotti, Spedding, Wilhelm

Associate Professors: Martin, Rosauer, Smyth

Undergraduate Study

Ceramic Engineering

For undergraduate curriculum in ceramic engineering leading to the degree Bachelor of Science, see *College of Engineering, Curricula*

Ceramic engineering deals with those products formed from natural and snythetic minerals, which are rendered durable by a process of heat treatment at high temperatures. These include most of the nonmetallic, inorganic substances manufactured into electronic components, glass of all types, porcelain enamels, abrasives, cements, ultrahigh temperature resistant refractories, many materials of construction, and other similar products

The ceramic engineer is concerned with the technical problems encountered in the research, development, control, production, and use of these products and materials and must also be well versed in the methods employed for forming, drying, and firing of ceramic raw materials The ceramic engineer receives a well-rounded education to fit into research, production, equipment and plant design, or sales engineering, depending upon the capabilities and inclination of the individual

Metallurgy

A student interested in a major in metallurgy will pursue studies leading to the degree Bachelor of Science in the College of Sciences and Humanities, see *Sciences and Humanities, Curriculum* Students majoring in metallurgy will usually select the following basic courses: 203, 270, 270L, 301, 302, 301L, 302L, 360, 361, 400, 401, 402, 402L, and three additional credits in courses numbered 400 or above. As supporting work, undergraduate majors find the following courses desirable. Math 165, 166, 265, 266, plus one additional course in mathematics, statistics, or computer science; Phys 221, 222, Chem 167, 167L, E M 274, 324. These lists of courses are not regarded as fixed requirements or as complete outlines of work necessary for the major Students will plan their complete programs with the help of their advisers.

Metallurgical Engineering

For the undergraduatre curriculum in metallurgical engineering, see *College of Engineering, Curricula*. The curriculum is based on a core of courses in chemistry, physics, mathematics, and metallurgical engineering principles A wide choice of electives makes it possible for students, in consultation with their adviser, to develop a program that best fits their particular interests and aptitudes. Elective programs should complement the core curriculum, avoiding undue specialization or aimless diversification.

The department offers a cooperative education program, usually requiring five years, that

combines classroom learning at the University with a minimum of four quarters of work experience with an industrial company The first industrial part of the program follows the sophomore year See *College of Engineering, Cooperative Programs*

The metallurgist or metallurgical engineer finds opportunities in many industries such as the metal-producing, refining, and processing industries or those that utilize metals, such as the automotive, aerospace, utilities, electronic, oil refining, and farm implement industries Persons may choose to work in the areas of production, sales or research. Students interested in teaching or research in metallurgy or metallurgical engineering should seriously consider graduate study

Minors

The following course selection guidelines are recommended for students wishing to minor in Materials Science and Engineering Technical minor 383, at least one of 231, 270, or 271, with the remainder of the required credits selected from M S E or other M S E-approved materials-related courses with a maximum of 6 credits from 170, 170L, 380, and 381 General minor A minimum of 9 credits from 170, 170L, 380, 381, and 385 with an additional 6 credits from M S E or other M S E-approved materials-related courses

Graduate Study

The department offers work for the degrees Master of Science (with thesis) and Doctor of Philosophy, with majors in ceramic engineering or metallurgy Also offered is the Master of Engineering degree (without thesis), with a major in materials science and engineering as well as minor work to students taking major work in other departments Students majoring in metallurgy may specialize in the areas of physical, chemical, and mechanical metallurrgy Research in the department is closely associated with the Ames Laboratory of the U S Department of Energy and the Engineering Research Institute, which provide support for graduate student research assistantships

Prerequisite to major graduate work is completion of an undergraduate curriculum in physical science or related engineering

Before admission to candidacy for the degree Doctor of Philosophy with a major in metallurgy, the student is required to demonstrate proficiency in French, German, or Russian by attaining a score of 525 in the Educational Testing Service examination or obtaining a grade of B or better in Fmch 101 and 102, Ger 101 and 102; or Rus 101 and 102 After satisfying either of the above requirements, the student must translate one journal article per quarter for three consecutive quarters, the articles and translations are approved by the major professor

There is no departmental foreign language requirement for students seeking the degree Doctor of Philosophy with a major in ceramic engineering However, students are encouraged to include the study of a foreign language as a part of their program.

Because nuclear energy technology is an important application of materials, there is a cooperative arrangement with the Department of Nuclear Engineering Students with majors in the Materials Science and Engineering Department interested in nuclear energy technology are encouraged to consider the following courses. Nuc E 401, 451, 471, 484, 535, 541, 582, M S E 375, 551, 552, 650

The department participates in the Energy Systems Engineering minor program and the interdepartmental program of Technology and Social Change (See Index)

Open to graduate students for minor credit only 301, 302, 301L, 302L, 321, 322, 337, 343, 344, 345, 351, 352, 360, 361, 370, 370L, 375, 401, 402, 402L, 410, 440, 441, 442, 445, 446

Courses Primarily for Undergraduate Students

101 Technical Lecture. (1-0) Cr ½ S Introduction to materials science and engineering professions Career opportunities

170. Introduction to Materials Used in Art and Technology. (3-0) Cr 3 F S A concept-oriented, basic course on materials intended for students of all disciplines Development of appreciation and understanding of basic properties of materials Emphasis on common applications of materials and their use in art and technology No science or mathematics background required

170L. Introduction to Metals Used in Art and Technology — Laboratory.. (0-6) Cr 2 F S *Prereq Credit or classification in 170* A laboratory course in scientific aspects of metals through interdependence of art, technology, and science Techniques of metal casting, forming, and joining Microscopic examination and property measurements conducted to illustrate response of metals to these processes Fee

203. Introduction to Metallurgical Engineering. (3-0) Cr 3 S *Prereq 270* Metal forming and consolidation processes Physical and mechanical properties of commercial alloys Selection of alloys and processing methods in terms of metal structures and properties Metallurgical information resources

230 Introduction to Ceramic Engineering. (4-3) Cr 5 F An introduction to ceramic processing and the engineering techniques applicable to material preparation, forming, and drying

231 Introduction to Ceramic Science. (3-3) Cr 4 S *Prereq Chem 167* Crystal structures of ceramic materials Relation of structure, bonding and imperfections to properties Introduction to mechanical, thermal and electrical properties of ceramic materials

270. Principles of Materials Science. (2-0) Cr 2 F S *Prereq Chem 167* Classification of materials by bonding, structure, crystalline, molecular, and amorphous solids Electrical, optical, and magnetic behavior of materials Elements of physical metallurgy An introduction to ceramic, polymer, and composite materials

270L. Introductory Physical Metallurgy Laboratory (1-3) Cr 2 F S *Prereq Credit or classification in 270* Introduction to crystal models, X-ray diffraction, and metallography, studies of effects of composition and processing variables on microstructure, and physical and mechanical properties Elements of termperature measurements and controls Primarily for metallurgy majors

271 Materials Science and Engineering. (3-0) Cr 3 F S *Prereq Chem 167 or 177, Math 166* Introduction to atomic bonding structure of crystals and polycrystalline aggregates, deformation of solids, phase equilibria, and transformations Applications to engineering properties Not acceptable for credit for a degree in ceramic engineering, metallurgical engineering, or metallurgy

298, 398, 498 Cooperative Education. Required of all cooperative students *Prereq Permission of department chairman* 298 Work periods for sophomores in a regularly established program 398 Work periods for juniors 498 Work periods for seniors Students must register for these courses prior to commencing each work period

301, 302. Physical Metallurgy. (4-0) Cr 4 each Yr *Prereq 301 231 or 270 or 271, 302 301* 301 Stereography, X-ray diffraction, basic dislocation theory deformation of metals, grain boundaries, grain growth, vacancies, diffusion, 302 nucleation, solidification, recovery and recrystallization, solid solutions, precipitation hardening, twinning and martensite reactions, transformation kinetics strengthening processes

301L. Metallography Laboratory. (0-6) Cr 2 F *Prereq Credit or classification in 301* Preparation and analysis of ferrous and non-ferrous metals Quantitative optical microscopy, scanning electron microscopy, powder X-ray diffraction, hardness testing

302L. Physical Metallurgy Laboratory. (0-6) Cr 2 S *Prereq Credit or classification in 302* Experiments are carried out and analyzed which involve the following topics Carburizing of steel, casting of bronze, brass and cast iron, Jominy end quench, induction hardening x-ray and metallographic evaluation of retained austenite, age hardening of aluminum alloys, and welding of plain carbon and stainless steels

321. Mechanical Behavior of Materials. (M E 321) See *Mechanical Engineering*

322. Manufacturing Processes. (M E 322) See *Mechanical Engineering*

330. High Temperature Technology (1-6) Cr 3 F *Prereq Phys 221, Chem 167* Principles of temperature measurement Use of thermoelectric, resistance, and optical measuring devices Method of temperature control Power supplies for furnaces Fuels and combustion stoichiometry

337. Engineering Materials (E M 337) See *Engineering Science and Mechanics*

340. Inspection Trip. Cr R S *Prereq Junior ceramic engineering classification* One-week trip inspecting ceramic plants and studying industrial methods of production Fee

341 Application of Statistics to Materials. (0-3) Cr 1 S *Prereq Stat 305* Application of statistical principles to problems concerned with materials

343. Electronic Ceramics (3-0) Cr 3 S *Prereq 231 Phys 222* Underlying causes and characteristics of electrical and magnetic behavior of ceramic materials Properties and production of common ceramic materials used for dielectric, optical, semiconductor ionic conductor and magnetic applications

344. Instruments for Materials Characterization (2-6) Cr 4 S *Prereq Phys 222* Characterization of inorganic materials with information obtained from light microscopy, X-ray analysis and electron beam instrumentation Correlatioon with microstructures

345. High Temperature Processes (3-3) Cr 4 S *Prereq 360 or Chem 321* Use of high-temperature treatment to effect atomic transport and densification through sintering and vitrification Prediction of final fired structure by means of phase equilibrium diagrams

351, 352 Engineering Materials (E Sci 351, 352) See *Engineering Science*

359 Materials Engineering with Applications in Agricultural Engineering (A E 359) (2-3) Cr 3 F *Prereq Chem 167, E M 274* Introduction to atomic bonding, structure of crystals and polycrystalline aggregates, phase equilibria, strength and deformation of solids Applications to engineering properties of metals Laboratory in welding, heat treatment, and testing of ferrous and non-ferrous alloys

360 Thermochemistry for Materials Science and Engineering. (3-0) Cr 3 F *Prereq Chem 167 or 177 Math 266* Basic laws of thermodynamics applied to materials systems Thermodynamic properties of pure substances, homogeneous solutions, and dissolved components Homogeneous and heterogeneous equilibrium Property changes for chemical reactions

361 Principles of Extractive Metallurgy (3-3) Cr 4 S *Prereq 360 or Chem 321* Applications of chemical equilibrium, thermodynamics and reaction kinetics to the understanding of metallurgical unit operations Introduction to diffusion, heat transfer and fluid flow principles and the utilization in extractive metallurgy processes

370 Principles of Nondestructive Testing (E M 370) (3-0) Cr 3 S *Prereq, Phys 112 or 222* Radiography ultrasonic testing, magnetic particle inspection, eddy current testing, dye penetrant inspection and other less common techniques Physical bases of test, materials to which applicable, types of defects detectable, calibration standards, and reliability, safety precautions

370L. Nondestructive Testing Laboratory. (E M 370L) (0-3) Cr 1 S *Prereq. Credit or classification in 370* Application of non-destructive testing techniques to detection of flaws in materials

371. Materials for Aerospace Applications (3-0) Cr 3 F *Prereq Chem 167, E M 324* Introduction to atomic structure of solids, phase equilibria, transformations and mechanical properties Selection and properties of aerospace materials Primarily for aerospace engineering students

375. **Nuclear Materials and Radiation Effects.** (3-0) Cr 3 F *Prereq. 231 or 270 or 271* Materials for fission and fusion reactors Radiation flux and spectrum, collision dynamics, and defects in materials. Displacement radiation damage and transmutations. Defect clusters, voids, and bubbles, and effects on mechanical properties Fuel, cladding, control, core structure, pressure vessel, shielding, and balance-of-plant materials Current materials topics in nuclear technology

380. **Ceramics in the Modern World.** (3-0) Cr 3 S Ceramic materials and their utilization History of ceramics from ancient to modern times, products, case histories, social problems, and technological impact of the ceramic industry Mathematics and chemistry background not required Not acceptable for credit for a ceramic engineering degree

381 **Glass in the Modern World.** (3-0) Cr 3 F SS Evolution of artistic and useful glass products Making of glass products Impact of glass industry on economic and ecological environment Mathematics and chemistry background not required. Not acceptable for credit for a ceramic engineering degree

383. **Polymers and Composites.** (3-0) Cr 3 F *Prereq Chem 167 or 177, E M 325.* Properties of polymers as a function of chemical composition, atomic arrangement, and molecular architecture. Processing, fabrication, and properties of thermoset polymers, thermoplastic polymers, glass reinforced plastic, boron-epoxy composites, and graphite-epoxy composites

385 **Resource Recovery.** (3-0) Cr 3 S *Prereq Junior classification* Aspects of industrial and municipal solid waste origins, problems and possible solutions Technological and social needs

400 **Metallurgy Seminar** (1-0) Cr 1 F Topics of current interest in metallurgy

401, 402 **Mechanical Metallurgy.** (3-0) Cr 3 each F S *Prereq 401 302, E M 324, 402 401* 401 Stress-strain, elastic and plastic deformation, testing methods and principles, creep and stress rupture, strengthening mechanisms 402 Fracture mechanics, metal forming processes, failure analysis, codes and standards

402L. **Mechanical Metallurgy Laboratory.** (0-6) Cr 2 F *Prereq Credit or classification in 402* Tension and impact testing, residual stresses, creep, stress rupture and fatigue tests

410 **Physical Metallurgy** (3-0) Cr 3 F *Prereq Chem 167 or 177, Math 266* Introduction to physical metallurgy for seniors or graduate students in science or engineering who have little or no prior preparation in metallurgy Not acceptable for credit for students in metallurgy or metallurgical engineering

421 **Metallurgical Engineering Design.** (3-0) Cr 3 S *Prereq 402* Application of physical, chemical and mechanical metallurgical principles to design of metal parts and processes

440 **Mechanical and Thermal Properties of Ceramic Materials.** (3-0) Cr 3 F *Prereq E M 324* Fundamentals of mechanical and thermal behavior of ceramic materials Properties and production of common ceramic materials used for mechanical and thermal applications

441 **Refractories.** (3-0) Cr 3 F *Prereq 360, 302 or 345* Mineralogy, manufacture and service characteristics of fireclay, high alumina, silica, basic and carbon refractories Use of refractories in metallurgical and ceramic industries

442 **Vitreous State.** (3-3) Cr 4 S *Prereq Chem 167* Theory of the vitreous state Structure and properties of inorganic glasses, melting, forming and annealing methods Application of vitreous coatings to metal

445, 446. **Ceramic Engineering Design.** 445 (2-3) Cr 3 446 (1-3) Cr 2 Yr *Prereq 445. 330, 345, Phys 222, 446 445* 445 Design and analysis of furnaces 446 Design, analysis, implementation and demonstration of a ceramic process

490 **Independent Study.** Cr arr Investigation of individual research or special topics
A Metallurgy
B Ceramic Engineering
H Honors

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates.

501 **Thermodynamics of Physico-chemical Processes in Solids.** (3-0) Cr. 3 F *Prereq 301 or 345, 360, or Chem 321, Math 266* Review of basic principles, thermodynamic potentials, stability principles, effects of strain energy, solution thermodynamics, free-energy-composition diagrams, and thermodynamic driving forces Nucleation and spinodal decomposition theory Solidification

502. **Diffusion in Metals and Kinetics of Physical Metallurgical Reactions.** (3-0) Cr 3 S *Prereq 501* Mechanism of diffusion Phenomenological aspects Diffusion applied to kinetic processes Anelesticity Precipitation and segregation reactions Recovery and recrystallization Order-disorder reactions Displacive transformations

503. **Mechanical Behavior of Materials.** (3-0) Cr 3 F *Prereq Phys 222, Math 266* Mechanical behavior of materials based on an atomic and microstructural viewpoint Stress and strain, dislocation mechanics, plasticity, yield criteria. Stress and strain concentrations Brittle and ductile fracture, statistical aspects of fracture, McClintock hole growth model Thermal fracture Fatigue and creep

512. **Introductory Metal Theory.** (2-0) Cr 2 Alt S., offered 1983 *Prereq Phys 222, Math 266* Free electron theory and band theory Brillouin zones and Fermi surfaces, electronic conductivity and scattering processes, electronic heat capacities, and comparison of metals to semiconductors

513. **Advanced Extractive Metallurgy.** (2-0) Cr 2 Alt S., offered 1982 *Prereq 360 or Chem 321* Occurrence and production of metals, including the less common metals Analysis of economic, stoichiometric, and thermodynamic principles in chemical metallurgy

514 **Applications of Metallurgical Thermodynamics.** (2-0) Cr 2 S *Prereq 501* Solubility of gases in metals, oxidation of metals and alloys, thermochemistry of steelmaking, atmosphere control with gas mixtures, special applications of Clausius-Clapeyron equation, use of Richardson-Jeffes charts, thermodynamics of alloys

518 **Magnetism and Metallurgy of Magnetic Materials** (2-0) Cr 2 Alt S., offered 1983 *Prereq Math 266* Physical and metallurgical principles of soft and hard magnetic substances including ferrites, thin films, and fine particles Major applications of ferromagnetic materials

520 **Chemical and Physical Metallurgy of Rare Earths** (2-0) Cr 2 Alt F., offered 1982 *Prereq 302 or 410 or Phys 325, 360 or Chem 321* Electronic configuration, valence states, minerals, ores, beneficiation, extraction separation metal preparation and purification, crystal structure, transformation, melting and boiling points, chemical behavior, inorganic compounds, alloy chemistry, nature of the chemical bond, mechanical and elastic properties, magnetic properties, resistivity, and superconductivity

521 **Properties of High Polymers** (M E 521) See *Mechanical Engineering*

522 **Structure, Properties and Heat Treatment of Ferrous and Non-ferrous Alloys.** (3-0) Cr 3 F *Prereq 302 or 331 or 410* Application of fundamental concepts of phase transformations, heat flow, mechanical behavior, and structure-property relations to the problems of heat treatment and selection of steels and aluminum, copper and titanium alloys

523. **Corrosion and Oxidation.** (2-0) Cr 2 F *Prereq 360 or Chem 321* Study of origin, development, and current applicability of theories of corrosion and oxidation of metals

524 **Casting and Welding of Metals** (3-0) Cr 3 Alt S offered 1982 *Prereq 301 or 344 or 410* Dendritic growth and control of macrostructure in castings, ingots, and continuous cast metals Porosity and its control Riser and gating design Mechanical properties of cast metals Welding characteristics of steels and important non-ferrous alloys

525. **X-Ray Diffraction.** (3-0) Cr 3 S *Prereq 301 or 344 or 410* Introduction to theory of x-ray and neutron diffraction, symmetry operations, space groups and reciprocal lattice Laue and power diffraction methods and their application to precise lattice parameters, determination of simple crystal structures, phase identification, orientation, texture, grain size, strain, residual stress and order-disorder Chemical analysis by x-ray method and small angle scattering

551. **Radiation Effects on Materials I: Fundamental Radiation Damage.** (Nuc E 551) (3-0) Cr 3 F *Prereq 270 or 271 or 375* Characteristics of radiation environments Scattering and absorption cross sections Determination of neutron flux and spectrum Defects in materials Experimental observations of radiation damage Effects of annealing and impurities

552. **Radiation Effects on Materials II: Application to Nuclear Systems.** (Nuc E 552) (3-0) Cr 3. S. *Prereq 551* Defect clusters, voids, and bubbles Radiation hardening and embrittlement Radiation effects on pressure vessel steels, fuel cladding, and core components Radiation-induced swelling Fuel restructuring and densification Radiation effects on materials for fusion reactors Radiation effects on non-metals, including semiconductors and polymers

560. **Scanning Electron Microscopy Characterization of Materials.** (E M 560) See *Engineering Science and Mechanics*

564. **Fracture and Fatigue.** (E M 564) See *Engineering Science and Mechanics*

568. **Plasticity and Creep of Materials.** (E M 568) See *Engineering Science and Mechanics*

569. **Mechanics of Composite and Combined Materials.** (E M 569) See *Engineering Science and Mechanics*

570. **Equilibrium and Nonequilibrium Ceramic Systems.** (3-0) Cr 3 Offered es err *Prereq 345* Review of classical thermodynamics, introduction to irreversible thermodynamics, driving forces, rate process theory, and phase equilibria in ceramic systems

571 **Ideal and Defect-Containing Crystalline Compounds.** (3-0) Cr 3 Offered as arr *Prereq 231 or 270, 345* Crystal chemistry of oxides and other inorganic compounds Crystal structure-property relationships for ideal structures and structures containing point defects such as Schottky and Frenkel defects plus defects created by non-stoichiometry and doping

573. **Measurements in High Temperature Systems.** (2-0) Cr 2 Offered as arr *Prereq 360 or Chem 321* Theory, limitations and problems of analysis of measurements at elevated temperature Furnaces and techniques for determination of mechanical, physical, structural, and chemical properties of ceramics at elevated temperatures

575. **Vitreous State** (3-0) Cr 3 Offered as arr *Prereq 442 or 360 or Chem 321* Advanced theory of the vitreous state Structure of glasses, nucleation theory, control of devitrification, composition-structure property relationships

580 **Biomaterials.** (E M 580, B M E 580) See *Engineering Science and Mechanics*

585. **Electron Microscopy of Inorganic Materials.** (2-3) Cr 3 Offered as arr *Prereq Phys 222* Microstructural and compositional characterization of materials by transmission electron microscopy, scanning electron microscopy, and electron microprobe analysis Energy and wavelength/elemental analysis and various electron diffraction modes Specimen preparation methods Intensive hands-on laboratory

590. **Special Topics.** Cr Var *Prereq Permission of instructor*
A Metallurgy
B Ceramics

595. **Topics in Material Science** Cr 1 to 3 each time elected Arr *Prereq Permission of instructor*
A Electronic Ceramics
B Refractories
C Colloids
D X-ray Diffraction Laboratory
E Microstructural Studies
F Mechanical properties of Ceramic Materials

Courses for Graduate Students, major or minor

601. **Transport in Solids.** (2-0) Cr 2 Alt S., offered 1983 *Prereq 501 or 570* Heat and mass transport in solids developed in terms of mathematical concepts Mathematical analysis of applied problems involving heat and mass transport in solid materials Atomistic description of diffusion in solids Stochastic aspects of atomic and ionic diffusion Phenomenological formulation of mass transport with applications to kinetic processes at elevated temperatures Experimental methods employed in solid state diffusion studies

602. **Martensitic Phase Transformation and Twinning.** (2-0) Cr 2 Alt F., offered 1982 *Prereq. 502.* Thermodynamic and crystallographic aspects of martensitic transformations Nucleation of martensite Diffusion-related and diffusionless characteristics Matrix algebraic analysis of shear transformations and twinning Phenomenological theories of martensite formation, shape change, habit plane, and orientation relationships. Stress-assisted martensite formation Shape memory alloys, application to heat engines and other devices

604. Transmission and Scanning - Transmission Electron Microscopy of Thin Crystals. (2-0) Cr 2 Alt S, offered 1982 *Prereq: 302 or 410* TEM and STEM and their application to observation of dislocations, voids and bubbles, precipitates, stacking faults, and magnetic and antiphase domain boundaries Selected-area and microdiffraction

605. Dislocation Theory and Applications. (2-0) Cr 2 Alt S, offered 1983 *Prereq. 503* Stress, strain, and displacement fields associated with dislocations. Self stress considerations of curved dislocations and line tension Self energy of dislocation loops and their stability Details of dislocation interaction with various barriers and calculations of associated force-distance curves. Applications to strengthening mechanisms

650. Nuclear Reactor Fuels. (Nuc E 650) (2-0) Cr 2 Alt F, offered 1981 *Prereq 375 or 552* Physical, chemical, nuclear, thermal, and mechanical properties of metallic, ceramic, and liquid fuels for nuclear reactors. Fuel cycles and fuel element design in thermal and fast reactors. Fuel fabrication Behavior of fission products. Fuel restructuring and densification Implications for safety and economics of nuclear reactors

670. Kinetics of Ceramic Processes. (3-0) Cr 3 *Prereq 570, 571.* Reaction rate theory and concepts of diffusion in ionic materials applied to analysis of important ceramic processes Solid state and gas-solid reactions, sintering, grain growth and polymorphic transformations

690. Advanced Topics. Cr Var *Prereq. Permission of instructor*
A Creative Component
B Other

695. Advanced Topics in Material Science. Cr 1 to 3 each time elected
A X-ray Scattering From Crystals
B Alloy Theory
C Metallurgical Thermodynamics

699. Research.

Mathematics

Wilfred E Barnes, Head of Department

Professors: Abian, Allen, Athreya, Barnes, Carlson, Colwell, Comette, Dahiya, Dickson, Fink, Hentzel, Homer, Isaacson, Keller, Lambert, Levine, Luecke, Maple, Mathews, Miller, Peglar, Pigozzi, Sanderson, Seifert, A K Steiner, E F Steiner, Tondra, Weiss, Wright

Emeritus Professors: Bortle, Hinrichsen, Lindahl, Vinograde

Associate Professors: Cain, Corones, Gauteson, Gregorac, Heckenbach, Heimes, Madych, Meany, Murdock, Rudolph, Smith, Sprague, Triggiani, Willson

Assistant Professors: Abatzoglou, Brandner, Davison, Epstein, Ho, Hogben, Johnston, Kegley, Kim, Lieberman, Maddux, Nelson, Peake, Peters, Robertson, Smiley, Walker, Wilson

Undergraduate Study

For the undergraduate curriculum in sciences and humanities, major in mathematics, leading to the degree Bachelor of Science, see *Sciences and Humanities, Curriculum.*

The program in mathematics offers training suitable for students planning to enter secondary school teaching, to work in mathematics and computation for industry or government, or to continue their studies in graduate school. The requirements for an undergraduate major in mathematics are designed so that the student may have opportunity for appropriate specialization to meet one or more of the foregoing objectives and, at the same time, obtain a thorough introduction to the mathematics underlying all of them

The requirements for an undergraduate major include
a) 175, 176, 270, 371, or 165, 166, 265, 266 or 267, 307,
b) 301, at least one of 302, 308, 471,
c) 414, 415, or 365, 465,
d) at least 9 additional credits chosen from 201 or any Math courses at the 300 level or above,
e) a grade of C or better in all courses prerequisite to a required course

The department strongly recommends that each student majoring in mathematics include in the program substantial supporting work beyond the minimum general education requirement of the college in one or more areas of application of mathematics, such as other mathematical sciences, engineering, natural science, or social science. In particular, it recommends that each student take Com S 111, 112, Phys 221, 222, and Stat 341, 342 (or Math 304) It also strongly recommends two years of French, German, or Russian for students contemplating graduate study in mathematics Credits earned in 104, 105, 140, 141, 142, 150, 151, 152L, 160, 195, 196 cannot be counted towards graduation by mathematics majors

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with majors in mathematics or applied mathematics, and minor work to students taking major work in other departments

Students desiring to do graduate work with a major in this department should present at least 12 semester credits of work in mathematics beyond calculus It is desirable that this include advanced calculus and abstract algebra

The M.S degree may be taken either with or without thesis Candidates for the M S and Ph D degrees must pass a written comprehensive examination covering basic graduate work. Ability to use two foreign languages (normally chosen from French, German, and Russian) as effective research tools in the student's area of specialization is required for the Ph D

Master of Science candidates must have one year and Doctor of Philosophy candidates must have two years of supervised teaching experience These minima are subject to increase in individual cases upon recommendation of the student's program of study committee and approval of the department head

Open to graduate students for minor credit only 301, 302, 304, 307, 308, 331, 332, 365, 385, 414, 415, 421, 426, 435, 436, 450, 465, 471, 481, 489

Courses Primarily for Undergraduate Students

10. Introductory Algebra. (4-0) Cr 0 SS only For students who do not have adequate facility with topics from the first year of high school algebra. Properties of integers and rational numbers, linear equations, polynomials and factors, systems of linear equations in two unknowns, fractional expressions, radical expressions

20. High School Geometry. (4-0) Cr 0 SS only For students who do not have adequate facility with topics from high school geometry Elements of Euclidean geometry including congruence, parallel lines, circles, similar polygons, perimeters and areas, surface areas and volumes.

30. Intermediate High School Algebra. (4-0) Cr 0 F SS *Prereq: 1 year of high school algebra* For students who do not have adequate facility with topics from the third semester of high school algebra. Systematic review of introductory algebra, linear equations and inequalities, systems of linear equations, polynomial equations, fractional equations, radical equations, binomial expansion, exponents, logarithms, and graphs

[a]104. Introduction to Probability and Matrices. (3-0) Cr 3 F S *Prereq 1½ years of high school algebra* Permutations, combinations, probability, binomial and multinomial theorems, matrices, Markov chains, expected value

105. Introduction to Mathematical Ideas. (3-0) Cr 3 F S *Prereq 1 year of high school algebra.* Topics selected from number theory, algebra, logic, and geometry with emphasis on their non-technical content

125. Calculus Laboratory I. (0-2) Cr 1 F S *Prereq Classification in or credit for one semester of calculus* Problems arising from a numerical, algorithmic approach to calculus solved by means of interactive computing

126 Calculus Laboratory II. (0-2) Cr 1 F S *Prereq 125, classification in or credit for a second semester of calculus.* See description for 125

140A, 140B. Fundamentals of Algebra for Science and Higher Mathematics. (4-0), (3-0) Cr 3 F S SS *Prereq 1½ years of high school algebra, 1 year of high school geometry* Coordinate geometry, complex numbers quadratic and polynomial equations, functions, graphing, systems of equations, exponential and logarithmic functions, determinants 140A is for students needing an extra contact hour to review prerequisite material 140B is for students not needing such a review

[c]141. Trigonometry. (2-0) Cr 2 F S.SS *Prereq 1½ years of high school algebra, 1 year of high school geometry, or classification in 140 May be taken concurrently with 140* Trigonometric functions and their inverses, solving triangles, trigonometric equations, polar coordinates, graphing

[c]142. Trigonometry and Analytic Geometry. (3-0) Cr 3 F S SS *Prereq 1½ years of high school algebra, 1 year of high school geometry, or classification in 140 May be taken concurrently with 140* Trigonometric functions and their inverses, solving triangles, trigonometric equations, polar coordinates, standard equations of lines and conic sections, conics in polar form, graphing of rational functions, quadric surfaces

[a]150. Mathematics for Business and Social Sciences I (3-0) Cr 3 F S SS *Prereq 1½ years of high school algebra* Linear equations and inequalities, linear programming, matrix algebra, discrete probability

[d]151. Mathematics for Business and Social Sciences II (3-0) Cr 3 F S SS *Prereq 104 or 150* Differential calculus, integral calculus, introduction to max-min theory for functions of two variables Will not serve as prerequisite for 265 or 266 or 270

152L. Computational Methods for Business and the Social Sciences. (0-2) Cr 1 F S *Prereq 150 and credit or classification in 151* Numerical solution of problems studied in 150 and 151 through use of interactive computing

[d]160. Intuitive Calculus. (4-0) Cr 4 S *Prereq 2 years of high school algebra, 1 year of geometry, 1 semester of trigonometry or 141 or 142* Analytic geometry, differentiation and integration of elementary functions Will not serve as a prerequisite for 265 or 266 or 270

[b],[d]165, 166. Calculus I, II. (4-0) Cr 4 each F S SS *Prereq 2 years of high school algebra, 1 year of geometry, 1 semester of trigonometry or classification in 141 or 142, 166: 165* Functions, limits and continuity differentiation, integration, polar coordinates, vectors

[b],[d]175, 176. Calculus with Differential Equations I, II (5-0) Cr 5 each F S *Prereq 175. Same as for 165, 176 175* Functions, limits and continuity, differentiation, integration, applications, polar coordinates, vectors, introduction to differential equations

195. Mathematics for Elementary Education I. (4-0) Cr 4 F S *Prereq. 1 year of high school algebra; classification in elementary education or child development* Language of sets, systems of whole numbers, numeration and algorithms for whole numbers, topics from number theory, geometric concepts

196. Mathematics for Elementary Education II. (2-0) Cr 2 S *Prereq 195* Topics in mathematics of current importance to prospective elementary teachers

201. Intermediate Mathematical Analysis. (3-0) Cr 3 F.S. *Prereq 166 or 176.* The real number system, functions, and important theorems from calculus

Emphasis on developing mathematical maturity Primarily intended for mathematics majors

226. Differential Equations Laboratory. (0-2) Cr 1 F S *Prereq Classification in 266 or 267 or 371* Analytical methods for solution of elementary differential equations supplemented by basic numerical methods for approximate solutions. Programming various algorithms for use on interactive computers Offered on satisfactory-fail basis only

[b]**265 Elementary Multivariable Calculus.** (4-0) Cr 4 F S SS *Prereq. 166.* Series, functions of several variables, gradients, multiple integrals.

[b]**266. Elementary Differential Equations.** (3-0) Cr 3 F S SS *Prereq 166 or 176* Elementary theory and applications of ordinary differential equations, matrices and solutions of linear equations, eigenvalue methods for systems of linear differential equations

[b]**267. Elementary Differential Equations and Laplace Transforms.** (4-0) Cr 4 F S SS *Prereq. 166 or 176* Same as 266 but also including Laplace transforms

[b]**270, 371. Linear Algebra, Multivariable Calculus and Differential Equations.** (4-0) Cr 4 each F S *Prereq 270 176, 371 270* Study of multivariable calculus based on the use of linear algebra Matrices and vector spaces, linear equations, eigenvalues, partial differentiation, line integrals, multiple integration, Green's theorem, differential operators, series, series solutions of differential equations, Laplace transforms, systems of differential equations, matrix exponentials

290 Special Problems. Cr 1 to 3 each time taken
H Honors

301, 302 Introduction to Abstract Algebra. (3-0) Cr 3 each Yr *Prereq 301 166 or 176, 302 301 and one of 266, 267, 270, 307* 301 Introduction to the theory of groups and rings. 302· Theory of fields, abstract vector spaces, and linear algebra

304 Introductory Combinatorics and Discrete Probability. (3-0) Cr 3 Alt S , offered 1983 *Prereq 166 or 176* Permutations, combinations, binomial coefficients, inclusion-exclusion principle, discrete probability, classical probability Additional topics selected from recurrence relations, generating functions, random walks, and Markov chains

307 Theory of Matrices. (3-0) Cr 3 F S SS *Prereq 1 semester of calculus* The algebra of matrices including vector spaces, simultaneous linear equations, determinants, quadratic forms, eigenvalues, and diagonalization over the real and complex numbers

308. Application of Linear Algebra to Discrete Optimization. (3-0) Cr 3 S *Prereq 270 or 302 or 307* Linear programming and topics chosen from game theory, transportation and assignment problems, discrete dynamic processes, and multiple objective linear programming

331, 332. Topology (3-0) Cr 3 each Yr *Prereq 331 265 or 270, 332 331* Topological properties of metric spaces with emphasis on R^n, sequences, continuous functions, completeness, compactness Abstract topological spaces and related properties, including compactifications, connectedness and fundamental groups

365. Complex Variables with Applications. (3-0) Cr 3 F S *Prereq 265 or 371* Functions of a complex variable, including differentiation, integration and series expansions, residues, evaluation of integrals, conformal mapping

385. Introduction to Partial Differential Equations (3-0) Cr 3 F S SS *Prereq 371, or 265 and one of 266, 267* Fourier series, separation of variable methods, Bessel series and Legendre polynomials, introduction to Sturm-Liouville theory

414, 415. Advanced Calculus. (3-0) Cr 3 each Yr *Prereq 371, or 265 and 307* 414 A careful development of calculus of functions of a real variable limits, continuity, differentiation, integration, series 415 Calculus of functions from R^n to R^m, linear and topological properties of R^n, limits, continuity, differentiation, implicit functions, multiple integrals, line and surface integrals, Stokes' theorem

421. Mathematical Logic. (3-0) Cr 3. Alt S , offered 1982 *Prereq. 201 or 301.* Validity, consistency, provability, completeness, definability, and decision problems for propositional calculus, predicate calculus, and generalized mathematical theories.

426. Mathematical Methods for the Physical Sciences. (3-0) Cr 3 F *Prereq. 385.* Primarily for first-year graduate students in physics and chemistry (Not a substitute for Math 526-527) Techniques presented provide students with mathematical background needed for study of electrodynamics, statistical mechanics, and quantum mechanics Emphasis on technique rather than theory Boundary value problems, contour integration and conformal mapping, spinors, matrix eigenvalue problems, introduction to integral equations and Green's functions

435, 436. Geometry. (3-0) Cr 3 each Yr *Prereq 435. 270 or 307, 436. 435* Euclidean geometry through properties invariant under similarity transformations, projective geometry by use of synthetic and analytic methods, topics chosen from finite geometry, non-Euclidean geometry and crystallography

450. Number Theory. (3-0) Cr 3 Alt S , offered 1983 *Prereq 301* Properties of the integers Diophantine equations, prime number distribution and representation problems

465. Advanced Calculus for Applied Mathematics. (4-0) Cr 4 F S SS *Prereq 265 or 371* Certain frequently applied mathematical concepts presented with enough theory to promote understanding of applications Calculus of functions of several variables, including vector calculus, line, surface, and multiple integrals, Stokes' theorem, divergence theorem, infinite series

471. Computational Linear Algebra and Fixed Point Iteration (Com S 471) (3-0) Cr 3 F S SS *Prereq 270, or 265 and one of 266, 267, knowledge of FORTRAN* Computational error, solutions of linear systems, least square methods, similarity methods for eigenvalues, non-linear equations, fixed point iteration in one and several variables, Newton's method in several variables

481. Numerical Solution of Differential Equations and Interpolation. (Com S 481) (3-0) Cr 3 F S *Prereq 371, or 265 and one of 266, 267, knowledge of FORTRAN* Orthogonal polynomials, least square and spline methods, numerical differentiation and integration, Euler, Taylor, Runge-Kutta, and predictor-corrector methods for solution of systems of ordinary differential equations

489. History of Mathematics. (3-0) Cr 3 S *Prereq Some knowledge of geometry and calculus recommended* Development of mathematical ideas through the eighteenth century, with some emphasis on primary sources

490 Independent Study Cr 1 to 3 each time taken *Prereq 201 or 301*
H Honors

497. Teaching Secondary School Mathematics. (3-0) Cr 3 F *Prereq 15 credits in college mathematics* Techniques for teaching secondary mathematics students, use of calculators in secondary schools

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[a]Either 104 or 150 may be counted toward graduation, but not both.

[b]Both of the sequences 165, 166, 265, 266 or 267 and 175, 176, 270, 371 will prepare a student for further study in 300-400 level mathematics courses. The main differences are that the 175, 176, 270, 371 sequence moves at a faster pace, introduces differential equations earlier, and places more emphasis on the use of linear mathematics. Credit for courses from both sequences, which contain a large amount of similar material, may not count toward graduation

[c]No more than 3 credits of 141, 142 may count toward graduation

[d]Only one of the 165-166, 175-176 sequences or 151 or 160 may be counted toward graduation.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

504, 505. Abstract Algebra. (3-0) Cr 3 each Yr *Prereq 302* Algebraic systems and their morphisms, including groups, rings, and linear algebra.

507. Numerical Solution of Ordinary Differential Equations. (Com S 507) (3-0) Cr 3 F *Prereq 481 or 465 or 415, knowledge of FORTRAN* One step methods for initial value problems, one-step methods for systems, multistep methods, boundary-value problems Examples using university computers

509. Computational Methods of Linear Algebra. (Com S 509) (3-0) Cr 3 S *Prereq. 270 or 302 or 307, knowledge of FORTRAN* Numerical methods involved in the solution of linear systems, matrix inversion, eigenvalue problems (symmetric and nonsymmetric), completion method, ill-conditioned matrices, linear inequalities Examples using university computers

510. Linear Algebra. (3-0) Cr 3 F *Prereq: 302 or 307* Brief review of elementary linear algebra, followed by advanced topics, canonical forms, inner product spaces, bilinear forms, tensor products, and applications to other branches of mathematics

511, 512. Functions of a Single Complex Variable. (3-0) Cr 3 each 511 F.SS., 512· S. *Prereq: 465 or 415.* Topological concepts for extended complex plane, analytic functions, conformal mappings, integration, power series, Laurent series, Cauchy residue theorem, evaluation of real integrals, harmonic functions, analytic continuation.

514, 515. Real Analysis. (3-0) Cr 3 each Yr *Prereq 415* Basic concepts of topological spaces, function spaces, measure and integration.

521, 522. Applied Mathematics. (3-0) Cr 3 each 521 F SS , 522· S *Prereq. 521 365, 385, 522 521* 521 Solution methods for classical linear partial differential equations. Series methods, Laplace and Fourier transforms, Green's functions, and other techniques 522· Approximate solutions to partial differential equations, emphasis on the finite element method

524. Theory of Automata. (3-0) Cr 3 S *Prereq: 301* Combinatorial theory of automata. various mathematical models of computation and their comparison, finite state machines. Turing machines, the halting problem Algebraic theory of automata structure of finite transition algebras and semigroups

526, 527. Mathematics of Classical and Quantum Physics. (3-0) Cr 3 each Yr *Prereq 365 or 426, 385.* Linear operators on finite and infinite dimensional vector spaces. Eigenvectors, diagonalization, Hilbert space, orthogonal series, analytic functions, Green's functions, integral equations

528, 529. Special Functions. (3-0) Cr 3 each Yr *Prereq 365* Gamma and beta functions, classical polynomials, Legendre and Bessel functions, elliptic integrals, and other functions of hypergeometric type A unified treatment of the special functions arising in applied mathematics

531, 532. Introduction to Functional Analysis. (3-0) Cr 3 each Alt Yr , offered 1981-82 *Prereq. Permission of instructor* Fundamental theory of normed linear spaces and algebras emphasizing aspects that provide a framework for study of boundary-value problems, eigenvalue problems, harmonic analysis, and analytic function theory Hahn-Banach theorem, Banach-Steinhaus theorem, Gelfand representation, elementary spectral theory for operators in Hilbert space

534, 535 Topology. (3-0) Cr 3 each Yr *Prereq Permission of instructor* Introduction to general topology and homotopy theory

537, 538. Algebraic Topology. (3-0) Cr 3 each Alt Yr , offered 1982-83 *Prereq 302, 332* Foundations of algebraic topology Homotopy and homology groups, fibrations, applications to manifolds

554 Probability. (Stat 554) (3-0) Cr 3 Alt F , offered 1982 *Prereq Stat 542* Occupancy problems, generating functions, compound distributions, recurrent events, characterizations of discrete distributions, urn models with applications

555. Stochastic Processes. (Stat 555) (3-0) Cr. 3 S *Prereq Stat 542* Basic theory and applications of stochastic processes including the Poisson process, the Wiener process, discrete-time stationary and nonstationary Markov chains, and continuous-time Markov chains

557, 558. Ordinary Differential Equations. (3-0) Cr 3 each Yr *Prereq· 266 or 267 or 371, 270 or 302 or 307; 415 or 465.* The initial-value problem, existence and uniqueness theorems, linear systems, stability and asymptotic behavior of solutions, dynamical systems, two-point boundary-value problems

562. Tensor Analysis and Manifolds. (3-0) Cr 3. Alt S , offered 1982 *Prereq. Permission of instructor.* Coordinate systems and transformations, differential forms, Riemannian metrics, covariant differentiation, curvature tensors, geometry of surfaces in Euclidean space

564. Theory of Groups. (3-0) Cr 3 Alt. S., offered 1983. *Prereq 505* Commutators, p-groups, nilpotent groups, solvable groups, permutation groups, free groups, semidirect products, introduction to representation theory

567. Boolean Rings. (3-0) Cr 3. SS. *Prereq. Permission of instructor* Structure of semisimple commutative rings and their representations Atomicity and completeness. Stone space of Boolean rings. The field of Borel and Baire sets. Theorems on extension of homomorphisms. Application to mathematical logic and measure theory

568. Theory of Rings. (3-0) Cr 3. Alt. S , offered 1982. *Prereq: 505.* Selected topics from the structure theory

for various classes of rings, including the theory of radicals and rings with chain conditions

571, 572. Mathematical Logic. (3-0) Cr 3 each Alt Yr , offered 1981-82. *Prereq: 421.* Algebraic structures in logical systems, recursive functions, consistency, undecidability and incompleteness of axiomatic theories, results of Gentzen and Godel, theory of models, ultraproducts and ultralimits, nonstandard analysis.

581, 582. Axiomatic Set Theory. (3-0) Cr 3 each Yr *Prereq Permission of instructor* Axiomatic considerations, model and proof theory, Zermelo-Fraenkel axioms, classical theorems, transfinite methods, ordinal and cardinal numbers and their arithmetic Von Neumann-Bernays-Godel axioms, inaccessible cardinals, consistency and independence results of Godel, Cohen, and others, method of Forcing

584. Category Theory. (3-0) Cr 3 Alt. F , offered 1981 *Prereq: 302* Categories and functors and their applications.

585, 586. Partial Differential Equations. (3-0) Cr 3 each Alt Yr , offered 1981-82 *Prereq. 415 or 521 or 526* First order equations and systems, wave, heat and potential equations, Huygen's principle, fundamental solutions, maximum principle; variational methods

590. Special topics. Cr var.

Courses for Graduate students, major or minor

610. Seminar.

690. Advanced Topics. Cr var *Prereq: Permission of instructor*

A. Algebra
B Functional Analysis
C Measure Theory
D Approximation Theory
E Linear Algebra
F Calculus of Variations
H Harmonic Analysis
L Logic and Foundations
M Complex Analysis
N Numerical Analysis
O Ordinary Differential Equations
P Partial Differential Equations
S Set Theory
T Topology
U Automata Theory
V Optimization Theory

699. Research

Mechanical Engineering

Arthur E Bergles, Chair of Department

Professors: Bahadur, Baumgarten, Bergles, Cook, Fellinger, Hall, Henkin, Junkhan, Kavanagh, Larson, Mischke, Okiishi, Peters, Pletcher, Serovy, Woods

Emeritus Professor: Black

Associate Professors: Bathie, Colver, Joensen, Myers, Wilson

Assistant Professors: Flugrad, Kuehn, Lee, Nelson, Shapiro, Van Meter

Undergraduate Study

For the undergraduate basic curriculum in mechanical engineering leading to the degree Bachelor of Science, see *College of Engineering, Curricula.*

Mechanical engineers are intimately involved with the processing, distribution, and use of energy; the processing of material; the control and automation of systems of production, the development of man-machine systems; and the development of vehicles of transport. About one-fourth of all engineers practicing today have been educated as mechanical engineers Their activities include research, development, design, construction, testing, production, operation, sales, and technical management

The undergraduate curriculum in mechanical engineering requires a broad foundation in mathematics and the fundamental sciences of physics and chemistry. This background is extended and organized for application in solid mechanics, fluid mechanics, thermodynamics, heat transfer, electrical phenomena, and materials Additional courses in the design of experiments and engineering analysis provide the basis for real-problem solutions in design courses.

Technical electives are provided to give the student the choice of additional broad or specialized extensions Organized sequences of technical electives may be chosen from areas which represent the major teaching and research areas in the department These optional areas of specialization are energy conversion and utilization, machines and systems, materials and manufacturing, thermal and environmental engineering, and vehicle propulsion.

A comprehensive sequence of electives in social and humanistic studies is a vital and integral part of the curriculum The department collaborates in a program in the history of engineering Students are encouraged to broaden their educational objectives by examining the offerings of all departments of the University and integrating additional studies into their educational plan

The basic curriculum prepares students to enter established areas of mechnical engineering or to accept newer challenges such as environmental protection, energy conservation, biomedical engineering, or similar interdisciplinary endeavors The elective opportunity provides for additional emphasis in terms of the student's educational goals, whether they be immediate entry into industry or further study at the graduate level.

A five-year cooperative education program is available to students in the department

The department cooperates with the Department of History in the offering of courses in the history of technology of interest to engineering students See listings below under *Courses in History of Technology.*

Graduate Study

The department offers work for the degrees Master of Science, and Doctor of Philosophy with major in mechanical engineering, and minor work to students taking major work in other departments. Course offerings may be used in co-major or minor programs for students of other departments

At the time of admission graduate students who have not completed an undergraduate program of study substantially equivalent to that required of undergraduate students in the department can expect that additional supporting course work, as determined by their program of study committee, will be required

The graduate program emphasizes advanced study, including design and research, in such areas as fluid mechanics and turbomachinery, fluid power and controls, heat transfer, machines and systems, materials and manufacturing processes, and thermodynamics and energy utilization Instrumentation and design of experiments are applied to all of these areas Reliability, computational, dynamic, environmental, materials, and legal considerations in design are emphasized

The department participates in the interdepartmental minor program of Energy Systems Engineering (See Index)

The department encourages students to broaden their education by participating in minor programs in established departments, interdepartmental programs, or such other experiences as approved by their program of study committees.

The requirements for advanced degrees are established by the student's program of study committee A foreign language requirement exists only for the degree Doctor of Philosophy when the student's program of study committee deems it appropriate to a specific program of study It is possible to arrange a program of study for the Master of Science on a nonthesis basis

Open to graduate students for minor credit only: 310, 311, 312, 321, 322, 331, 332, 335, 360, 411, 412, 414, 415, 436, 441, 442, 443, 444, 445, 446, 447, 448, 451, 460, 470, 475

Courses Primarily for Undergraduate Students

100. Technical Lecture. (1-0) Cr R S Field of mechanical engineering, its opportunities and requirements

201. Industrial Inspection. Cr R S *Prereq Sophomore mechanical engineering classification* Visitation of industries Expenses required

253. Introduction to Mechanical Engineering. (3-0) Cr 3 F S *Prereq Chem 167L, Phys 221, Math 166, Fr E 155L* Introduction to analysis, experiment and design in mechanical engineering Empiricism, dimensional analysis, measurement, confidence in conclusions drawn from experiment Experience with direct and inferential measurements Interactive computing

298, 398, 498. Cooperative Education. Required of all cooperative students *Prereq Permission of department chairman* 298. Work periods for students with sophomore standing in a regularly established program 398 Work periods for juniors 498 Work periods for seniors Students must register for these courses prior to commencing each work period

301 Mechanical Engineering Seminar. Cr R S *Prereq Junior mechanical engineering classification*

310 Mechanisms. (3-0) Cr 3 F S SS *Prereq 253, E M 345* The design problem and the role of interactive computing Theory of machines, kinematic and dynamic analysis of mechanisms Synthesis methods

311. Mechanical Systems. (2-2) Cr 3 F S *Prereq. 310 Math 267, E E 441* Mechanical systems, their equations of motion and dynamic response Fundamentals of industrial automatic control Laboratory experiments and problems

312. Design of Mechine Elements. (3-0) Cr 3 F S SS *Prereq 310, 321* Philosophy of design Failure models useful in fatigue and distortion circumstances Analysis selection and synthesis of machine elements

321. Mechanical Behavior of Materials. (MSE 321) (2-2) Cr 3 F S SS *Prereq: M S E 270, E M 324* Application of the basic principles of structure of solids to the study and control of mechanical properties Qualitative and quantitative relationships between microstructure and mechanical properties.

322. Manufacturing Processes. (2-2) Cr 3 F S SS *Prereq: 321* The relationship between material properties, manufacturing processes, and product properties The basic processes (casting, welding, forming, and machining) and the functional charactenstics of equipment Manufacturing considerations in design

***330. Thermodynamics.** (3-0) Cr 3 F S SS. *Prereq Math 265, Phys 222, junior classification.* First and second law of thermodynamics Properties and processes for pure substances. Selected applications including cycles for power and refrigeration

*331 **Engineering Thermodynamics I.** (4-0) Cr 4 F S *Prereq Math 265, Phys 222, junior classification* Fundamental concepts based on zeroth, first and second laws of thermodynamics Properties and processes for ideal gases and solid-liquid-vapor phases of pure substances Vapor cycles for power and refrigeration Constant composition gas mixtures Psychrometry and introduction to air conditioning processes

332. **Engineering Thermodynamics II.** (3-0) Cr 3 F S *Prereq 331* Air tables, one-dimensional compressible flow Compressors and turbines Air standard cycles for engines and turbines Material and energy balances for combustion processes Thermochemistry

335. **Fluid Flow** (3-0) Cr 3 F S SS *Prereq 331, E M 345, Math 266 or 267* Incompressible and compressible fluid flow fundamentals Dimensional analysis and similitude Internal and external flow applications

*336 **Elements of Heat Transfer.** (3-0) Cr 3 S *Prereq 330 or 331, 335 or E M 378* Solution of practical engineering problems involving transfer of heat by conduction, radiation, convection

360 **Engineering Measurements and Instrumentation.** (2-3) Cr 3 F S *Prereq 311* Fundamentals of design, selection, and operation of components of measuring systems Measurement processes, analysis of data, and propagation of measurement uncertainty Applications Taught as an open laboratory

411 **Industrial Automatic Controls.** (2-2) Cr 3 S *Prereq 311* Methods and principles of automatic control Pneumatic, hydraulic, and electrical systems Representative applications of automatic control systems Mathematical analysis of control systems

412 **Legal and Environmental Considerations in Design.** (3-0) Cr 3 F *Prereq 312, senior classification in engineering* Failure modes associated with product environment Interaction between the legal profession, legislative bodies, standards and the design engineer, using a case study approach in design applications Litigation involving designs, standards, and laws applicable to specific designs surveyed The influence of laws and standards upon design

414 **Hydraulic Systems and Control.** (3-0) Cr 3 S *Prereq 311, 335* Characteristics and design of pumps Hydraulic motors, system components, system analysis, feedback control and stability, control circuits, analog simulation

415 **Mechanical Systems Design** (0-6) Cr 3 F S *Prereq 311, 312* Solution of a total design problem involving a mechanical system, documenting decisions concerning environment impact, form and tolerance, material specification, thermal mechanical treatments, methodology of manufacture, presentation of the design

*436 **Heat Transfer.** (3-0) Cr 3 F S SS *Prereq 331, 335 or E M 378, Math 267 Heat transfer* by conduction, convection and radiation Similarity and analog concepts in heat, mass and momentum transfer Methods for determination of heat transfer coefficients Combined modes of heat transfer Heat exchangers

*440 **Principles of Heating and Air Conditioning** (4-0) Cr 4 S *Prereq Phys 222 or Arch 312* Basic principles of thermodynamics, heat transfer and refrigeration Computation of building heat loss and heat gain Principles of air distribution and duct design Applications of commercial equipment

441 **Refrigeration and Air Conditioning.** (3-0) Cr 3 F *Prereq Credit or classification in 336 or 436* Fundamentals of vapor compression, absorption, thermoelectric and air refrigeration systems Cryogenic cycles used to liquefy and separate gases Applications to air conditioning, food processing, low temperature storage, and superconducting systems

*442 **Heating and Air Conditioning Design** (2-3) Cr 3 S *Prereq 441* Analysis of building energy requirements Development of active and passive methods for heating and cooling structures Design and layout of heating, ventilation and air conditioning systems

*443. **Thermal Power Plants.** (4-0) Cr 4 F *Prereq E E 351 or 447* Introduction to thermodynamics Power plant cycles, fossil fuel electric generating station components, steam generators, steam and gas turbines, condensers, cooling towers and plant auxiliaries

444 **Elements and Performance of Power Plants.** (3-0) Cr 3 F *Prereq 332, credit or classification in 436* Analysis of power supply systems and their components turbines, steam generators, fans, pumps, heat exchangers, cooling water systems Environment pollution and control

445. **Internal Combustion Engines.** (2-2) Cr 3 F *Prereq 332, credit or classification in 436* Basic principles, thermodynamics, and performance of carbureted and fuel injection engines Engine-drive train-vehicle considerations Properties of engine fuels, combustion generated air pollutants Laboratory determination of engine performance

446. **Power Plant Design.** (2-3) Cr 3 S *Prereq 444* Design of a power plant to meet a specified power (energy) demand Selection and/or synthesis of principal components and pollution control equipment

447. **Gas Turbines.** (2-0) Cr 2 S *Prereq 332, 335* General principles, thermodynamics and performance of gas turbine engines Engine components, engine matching and selection Environmental considerations

448. **Fluid Dynamics of Turbomachinery.** (2-3) Cr 3 S *Prereq 335* Applications of principles of fluid mechanics and thermodynamics in performance analysis of turbomachines and related fluid system components Design problems

449. **Prime Mover Design.** (1-6) Cr 3 S *Prereq 312, 445 or 447 or 448* Design of prime movers for use as stationary, portable, or vehicular power sources Projects selected involve energy conversion systems utilizing rotating or reciprocating machines as well as unconventional machines

451. **Engineering Acoustics.** (E M 451) See *Engineering Science and Mechanics*

460. **Experimental Engineering.** (0-3) Cr 1 F S *Prereq 332, 360, 436* Experimental investigation of selected problems taken primarily from thermodynamics, fluid mechanics, heat transfer and applied areas of mechanical engineering Emphasis on application of classroom theory to experimental engineering and on interpretation and presentation of the results

470. **Computer-Aided Design.** (3-0) Cr 3 F *Prereq Senior classification in engineering and an elementary knowledge of FORTRAN* An examination of the morphology of design processes, the structure of the FORTRAN language, figures of merit, searching and optimization techniques leading to an algorithmic approach to design

475 **Numerical Methods in Mechanical Engineering.** (3-0) Cr 3 S *Prereq Credit or classification in 436* Numerical solution techniques common to many engineering problems, including those governed by ordinary and partial differential equations Digital computer applications to problems drawn primarily from thermal and mechanical systems

490. **Independent Study.** Cr 1 to 6 *Prereq Senior classification* Investigation of topics holding special interest of students and faculty Election of course and topic must be approved in advance

A Special Course Study
B Independent Literature Investigation
C Engineering Measurements and Instrumentation
D Heat Transfer
E Fluid Power and Controls
F Machines and Systems
G Materials and Manufacturing Processes
H Honors
J Thermodynamics and Energy Utilization
K Fluid Mechanics
L Turbomachinery

*Credit for only one course in the following groups of courses may be applied toward graduation 330, 331, 443; 336, 436; 440, 442.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

502. **Intermediate Machine Design.** (3-0) Cr 3 S *Prereq 415* Mathematical, experimental and simulative solutions to problems of synthesis in the design of machines .Choice of work determined by aptitudes and interests of the class and instructor

510 **Dynamics of Fluid Control Systems.** (3-0) Cr 3 F *Prereq 335, 411* Dynamical characteristics of fluid control systems and elements

514. **Computer and Reliability Considerations in Design.** (4-0) Cr 4 S *Prereq 312* Design methodology, structure of FORTRAN language and their relationship to algorithmic approaches to design Applications Statistical representation of loading, material properties and geometric form Probabilistic criteria for static and fatigue failure A posteriori reliability assessment A priori design to a reliability specification

515. **Advanced Design of Machine Elements.** (3-0) Cr 3 F *Prereq 312* Experimental, empirical, and rational methods for analysis and synthesis in the solution of advanced design problems in machine elements Creep and fatigue considerations.

516. **Kinematic Analysis and Synthesis of Mechanisms.** (3-0) Cr 3 S *Prereq 310* Analysis and synthesis of mechanisms using graphical, analytical, and computational methodologies

518. **Advanced Dynamics of Machinery.** (3-0) Cr 3 F *Prereq 311* Dynamic forces in machine members Principle of superposition Dynamic response of cam-follower systems Rotating and reciprocating machine unbalance Forces transmitted and machinery isolation Computer simulation of dynamic response

520. **Material and Manufacturing Considerations in Design.** (3-0) Cr 3 S *Prereq. 312, 322* Material selection consistent with functional requirements and process capabilities Redesign of a product to facilitate manufacturing. Tolerances, surface finish, and surface integrity Economic considerations Exploring the engineer's responsibility in light of conflicting interests of designer, manufacturer, management, customer, and the public

521. **Properties of High Polymers.** (M S E 521) (3-0) Cr 3 S *Prereq M S E 270 or 271* Molecular structure and packing, linear viscoelasticity, viscoelastic transitions, melt rheology, and mechanical properties Effects of chemical structure and morphology on mechanical properties emphasized, and engineering aspects discussed

526. **Friction and Wear.** (3-0) Cr 3 F *Prereq M S E 270 or 271, E M 324* Structure of solid surfaces, surface energetics and adhesion Theories of friction Forms of wear and relationship to microstructure and properties Effect of lubrication on friction and wear Tire and brake performance Friction in deformation processing

528. **Plastic Forming Processes.** (3-0) Cr 3 F *Prereq 322 or M S E 302* Concepts in continuum mechanics and physical metallurgy applied to the study of forming processes and their effect on the properties of the manufactured product

*530 **Intermediate Topics in Thermodynamics.** (2-0) Cr 2 S *Prereq 332* Thermodynamic analysis of unsteady flow processes General equations for properties of pure substances Real gas equations of state and processes for real gases Quantitative evaluation of availability and irreversibility in thermodynamic processes

531 **Statistical Thermodynamics for Engineers.** (3-0) Cr 3 Alt S , offered 1983 *Prereq 330 or 331* First and Second Laws of Thermodynamics, properties of gases, liquids, and solids from a microscopic viewpoint Introduction to non-equilibrium thermodynamics. Onsager relationships and determination of transport properties

532. **Thermodynamics of Compressible Flow I.** (3-0) Cr 3 F *Prereq 335* Thermodynamics of internal compressible flow One dimensional steady flow; isentropic flow, normal shock waves, constant area flow with friction and heat transfer Generalized one dimensional flow

533. **Thermodynamics of Compressible Flow II.** (Aer E 533) (3-0) Cr 3 Alt S , offered 1982 *Prereq 532* Theory of unsteady compressible flow and steady two dimensional supersonic internal flow Compression and expansion waves and wave interactions Applicetions

534. **Experimental Gas Dynamics.** (Aer E 534) (1-3) Cr 2 Alt S , offered 1983 *Prereq 332* Shock waves, explosions, and compressible flows of high speed and high enthalpy Equipment and instrumentation for flow visualization and measurement of thermodynamic properties, heat transfer, shock strength, and boundary layer phenomena. Use of shock tube as an experimental tool

535. **Hydrodynamic Lubrication.** (3-0) Cr 3 F *Prereq 312, 335* Theory of fluid film lubrication and application to bearing design

536. **Advanced Heat Transfer.** (3-0) Cr 3 S *Prereq. 336 or 436* Advanced treatment of heat transmission by conduction, convection and radiation Intended for those who require a general coverage of theory and methods but whose primary research interests are in other areas.

537. **Experimental Fluid Mechanics.** (E M 537) (1-3) Cr 2 S *Prereq. 571* Experimental aspects of fluid mechanics including fundamentals of measurement of flow field velocities, pressures, and temperatures.

540. **Solar Energy Thermal Systems.** (3-0) Cr. 3. S *Prereq: 336 or 436* Application of heat transfer and

thermodynamics to the design and analysis of solar energy collectors and systems.

541. Human Thermal Environments. (Arch 541) (3-0) Cr 3 Alt. F, offered 1982 *Prereq: 440 or 441 or Arch 412.* Investigation of physical, climatological, and physiological factors that influence human response to thermal environments. Analytical methods for evaluating thermal performance of buildings and for quantitatively expressing human response to indoor thermal environments.

542. Advanced Combustion. (3-0) Cr 3 S *Prereq: 332* Third Law and asolute entropy. Thermochemistry and energy balances. Gas phase equilibrium. Flame temperatures, speed and propagation. Reaction kinetics. Theories of the mechanisms of combustion. Air pollution control.

543. Energy Systems Engineering. (E E 543, Nuc E 543) (2-0) Cr 2 F *Prereq: One course in thermodynamics, E E 441, Econ 201 or 203 or I E 304* Potentials and limitations of energy sources. Energy conversion, utilization, and conservation in industrial, residential, and transportation systems. Energy-related economic environmental, social, and political considerations.

545. Vehicular Propulsion Systems. (3-0) Cr 3 S *Prereq: 532 and 548 or Aer E 412.* Analysis and selection of propulsion systems for vehicles.

546, 547. Computational Fluid Mechanics and Heat Transfer I, II. (Aer E 546, 547) (3-0) Cr 3 each Yr *Prereq: 546: credit or classification in 571 or Aer E 541, 547: 546.* 546: Introduction to finite difference methods used in modern engineering. Solution of example problems in fluid mechanics and heat transfer. 547: Application of computational methods to current problems in fluid mechanics and heat transfer.

548. Turbomachinery. (2-3) Cr 3 F *Prereq: 335* Intermediate level study of turbomachines and related fluid system components. Aerodynamic and aeromechanical performance measurement and evaluation.

551. Noise Source Analysis. (E M 551) See *Engineering Science and Mechanics.*

560. Design of Engineering Experiments I. (2-3) Cr 3 F *Prereq: Graduate standing, 1 undergraduate engineering laboratory course and elementary knowledge of statistics.* Fundamentals of design, selection and operation of instrumentation components of measuring systems. Techniques for analysis, interpretation, and presentation of experimental data. Error analysis and propagation of error. Statistical inference acceptance tests and comparison tests, precision and confidence limits on data resulting in points, lines, or curves.

561. Design of Engineering Experiments II. (3-0) Cr 3 Alt S, offered 1982 *Prereq: 360 or 560.* Design of experiments to determine what data to take, how much data to take, as well as to meet prescribed confidence limits on results. Selection of complete measurement systems to satisfy the response, sensitivity, resolution, isolation, and fidelity required by specifications of the experiment.

564. Fracture and Fatigue. (E M 564, M S E 564) (3-0) Cr 3 F *Prereq: E M 324 and any one of E M 337, E Sc 352, M S E 231, 270 or 271.* Materials and mechanics approach to fracture and fatigue. Fracture mechanics, brittle and ductile fracture, fracture and fatigue characteristics. Fracture and fatigue tests, thermal fracture, mechanics and materials designed to avoid fracture and fatigue.

571, 572. Advanced Fluid Mechanics. (E M 571, 572) See *Engineering Science and Mechanics.*

590. Special Topics. Cr 1 to 8. Investigation of problems of special interest to graduate students in mechanical engineering. Election of course and problem must be approved in advance. A through G, J through L. (See listing under 490.)

Courses for Graduate Students, major or minor

600. Seminar. (1-0) Cr R. F.

602. Advanced Machine Design. (3-0) Cr 3 *Prereq: At least two of 510, 514, 515, 516, 518, E M 514, 517, 544.* Concepts, principles, theories, and procedures useful for synthesis decisions in advanced machine design including computational aids with an emphasis on high speed applications. Choice of work determined by aptitudes and interests of the class and instructor.

***630. Advanced Engineering Thermodynamics I.** (3-0) Cr 3. Alt F, offered 1981 *Prereq: 331* Fundamental concepts of thermodynamics, including laws, temperature, entropy and general equations for property changes of non-reactive systems. Construction of tables of properties. Equilibrium criteria.

631. Advanced Engineering Thermodynamics II. (3-0) Cr 3 Alt F, offered 1982 *Prereq. 331* Nonequilibrium concepts in thermodynamics leading to rate processes in liquids and high temperature gases. Laws governing gas-liquid phase equilibria and evaporation rate, gas phase transport phenomena and chemical reaction rate. Combustion applications are droplet and surface burning, flame propagation in premixed and diffusion gases, and nozzle flow.

632. Particulate Flow. (3-0) Cr 3 Alt F, offered 1981 *Prereq 436* Concepts in single and multiparticle phenomena, particle interactions with fluids, other particles and walls, equations of multiphase ducted flow. Dense packing particle behavior including heat and mass transfer in fixed and fluidized beds.

636. Conduction Heat Transfer. (3-0) Cr 3 Alt. F., offered 1982 *Prereq: 436.* Techniques for analysis of problems involving steady-state and transient heat conduction in solids.

637. Convection Heat Transfer. (3-0) Cr 3 Alt S, offered 1983 *Prereq 436.* Heat transfer to internal or external forced convection flows under laminar or turbulent conditions. Free convection. Heat exchanger design considerations, including augmentation.

638. Radiation Heat Transfer. (3-0) Cr 3 Alt F, offered 1981 *Prereq 436* Techniques for analysis of radiation in enclosures. Radiative properties of surfaces. Radiative transfer in participating media. Combined modes of transfer. Approximate methods of analysis.

639. Two-Phase Flow and Heat Transfer. (3-0) Cr 3 Alt S, offered 1982 *Prereq. 436.* Hydrodynamics of adiabatic two-phase flow. Pool boiling. Forced convection and boiling condensation. Dynamic behavior of two-phase systems. Augmentation of boiling and condensing heat transfer. Applications in the power and process industries.

640. Advanced Thermal Environmental Engineering. (2-3) Cr 3 Alt F, offered 1981 *Prereq 441, 360 or 560* Application of non-steady thermodynamics analysis to the thermal performance of buildings. Investigation of part-load performance of systems.

650. Fluid Mechanics Seminar. (Aer E 650, E M 650) (1-0) Cr 1 each time taken F *Prereq: Permission of instructor* Special topics of current research interest to students and staff of departments concerned.

651. Advanced Topics in Fluid Mechanics. (E M 651) See *Engineering Science and Mechanics.*

690. Advanced Topics. Cr Var.

699. Research.

***Credit for both 530 and 630 may not be applied toward graduation.**

Courses in History of Technology

280, 281. Introduction to the History of Science. (Hist 280, 281) (3-0) Cr 3 each 280: F, 281: S 280: Ideas of nature from Babylonian to the Renaissance. 281: Science from the seventeenth-century scientific revolution to Darwin and Einstein.

284, 285. Introduction to the History of Technology and Engineering. (Hist 284, 285) (3-0) Cr 3 each 284: F, 285: S. 284: Technology in various civilizations from Mesopotamia, Egypt, Greece, and Rome to medieval and Renaissance Europe. 285: Technology in the Western world from the seventeenth to the twentieth century.

387. Science, Technology, and Society in Modern Europe. (Hist 387) Cr 3. Alt S. From the late eighteenth-century beginnings of the industrial revolution in Britain to World War I. Examination of scientists' and engineers' influence on society and of society on them.

489. History of American Science. (Hist 489) (3-0) Cr 3 Alt Yr. Science and its social relationships since the mid-nineteenth century, interaction of scientific discoveries and the development of society. Continuing impact of Darwinism and other scientific theories, science and social thought, modern medicine and public health, science and industry; science and agriculture, the social sciences, government and science, science and the consumer; the atomic age; big science, the environmental dilemma, the energy crisis, the role of science in a democracy.

Microbiology

(Bacteriology)

Paul A. Hartman, Chair of Department

Professors: Atherly, Durand, Hartman, Holt, Kraft, Lockhart, Pattee, Quinn, Walker, Williams

Associate Professors: Glatz, Loynachan

Undergraduate Study

For undergraduate curriculum in sciences and humanities, major in microbiology, leading to the degree Bachelor of Science, see *Sciences and Humanities, Curriculum.*

In this department, principal emphasis is placed on understanding the interrelationships of microorganisms in nature, the application of microbiology in agriculture and industry, and the study of fundamental life processes as exemplified by microorganisms. Varied careers are open to qualified graduates: in hospital and clinical laboratories, in federal, state, or local government organizations, and in research and development and quality-control laboratories maintained by the dairy and food processing, pharmaceutical, and fermentation industries, among others. Some fields of microbiology, especially advanced research, may require further training. Undergraduate work in the department is designed to provide sound preparation for graduate study.

Undergraduate programs usually include the following basic courses: 300, 310, 320, 400, 450, 490 and 575. Courses in the following areas are required as supporting work: biology, botany, quantitative analysis, organic chemistry and biochemistry; genetics; mathematical disciplines, physics, speech, zoology.

Graduate Study

The department offers work toward the Master of Science and Doctor of Philosophy with major in microbiology, and minor work to students majoring in other departments. Within the major the student may specialize in immunology, in virology; in food, applied, medical, or systematic bacteriology; or in microbial ecology, genetics, physiology, or morphology. Major graduate study in veterinary microbiology, soil microbiology, and dairy microbiology is offered in the departments of Veterinary Microbiology, Agronomy, and Food Technology, respectively.

Specific prerequisite to major work in microbiology is the completion of thorough course work in general microbiology, biology, organic chemistry, biochemistry, mathematical sciences, and physics. Minor study usually is selected from chemistry, biochemistry and biophysics, botany, zoology, genetics, mathematics, computer science, and statistics.

The department also participates in the interdepartmental programs in Immunobiology, Molecular, Cellular and Developmental Biology, and Water Resources (see Index).

Each graduate student must have received a grade of B or better in English composition or pass the Graduate English Examination within two semesters in residence.

Candidates for the Ph.D. degree must demonstrate their ability to translate scientific articles from one modern foreign language. Language examinations are administered by the department. Graduate students are encouraged to teach at least one laboratory section each year in residence.

Open to graduate students for minor credit only 310, 320, 400, 401, 402, 420, 421, 425 and 485

Courses Primarily for Undergraduate Students

300 Introductory Microbiology (2-6) Cr 4 F S SS *Prereq Biol 110, 1 semester of chemistry* The characteristics of microorganisms and their roles in disease, in the environment, and in industry

310 Pathogenic Microbiology. (3-4) Cr 4 F SS *Prereq 300 a course in organic chemistry* Study of pathogenic bacteria and other microorganisms Clinical laboratory techniques for the identification and characterization of pathogens

311 Introduction to Parasitology (Zool 311) See *Zoology*

320 Advanced General Bacteriology. (3-6) Cr 5 S *Prereq 300, a course in organic chemistry* A survey of the procaryotes with emphasis on bacterial physiology, cytology and ecology. The isolation, cultivation, and study of bacteria

400 Molecular Biology of Bacteria and Viruses. (3-0 or 3-4) Cr 3 or 4 F *Prereq 300, Gen 330* Survey of bacterial, plant and animal virology Emphasis on bacterial genetics and virus host-cell interactions Laboratory emphasizes mutagenesis and genetic characterization of bacteria and principles and techniques involved in the quantitation, isolation and, characterization of bacteriophage

401 Food Processing (F Tch 401) See *Food Technology*

402 Food Processing Laboratory (F Tch 402) See *Food Technology*

420 Food Microbiology (F Tch 420) (3-0) Cr 3 F *Prereq 300* The normal microbial flora of foods, microbiological indicators of contamination, food-borne infections and intoxications, food safety

421 Food Microbiology Laboratory (F Tch 421) See *Food Technology*

425 Food and Water Sanitation (F Tch 425) See *Food Technology*

450 Undergraduate Seminar. Cr 1 each time taken F S *Prereq Sp 212* Required of all undergraduate majors in microbiology Offered on a satisfactory-fail basis only

485 Soil Biology (Agron 485) See *Agronomy*

490 Independent Study Cr 1 to 5 F S SS *Prereq Permission of instructor*
H Honors

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

506. Host-parasite systems. (Zool 506) See *Zoology*

508 Vertebrate Virology (2-0 or 2-4) Cr 2 or 3 S *Prereq 400, permission of instructor required for laboratory* Molecular biology and pathology of vertebrate viruses Laboratory emphasizes the isolation, quantitation, and characterization of vertebrate viruses

509. Plant Virology. (PP SW 509) See *Plant Pathology, Seed and Weed Sciences*

520 Medical Immunology I. (VMPM 520, Imbio 520) See *Veterinary Microbiology and Preventative Medicine*

524 Veterinary Medical Mycology (VMPM 524) See *Veterinary Microbiology and Preventative Medicine*

525 Applied Microbiology. (3-0) Cr 3 S *Prereq 300, permission of instructor* Utilization of microorganisms in agriculture and industry

526 Advanced Vetarinary Virology. (VMPM 526) See *Veterinary Microbiology and Preventative Medicine*

550 Seminar. Cr 1 each time taken F S Required of all students taking major graduate work in microbiology Offered on a satisfactory-fail basis only

560 Immunoparasitology (Vet Pth 560) See *Veterinary Pathology*

575. Immunology. (Imbio 575) (3-0 or 3-6) Cr 3 or 5 F S *Prereq 300, laboratory by permission of instructor* Theories of immunity and immunization, antigen-antibody reactions Laboratory deals with preparation and use of vaccines and antisera, immunological techniques

585. Soil Microbiology and Biochemistry. (Agron 585) See *Agronomy*

Courses for Graduate Students, major or minor

600 Comparative Anatomy and Physiology of Bacteria. (3-0 or 3-3) Cr 3 or 4 F *Prereq Course in microbiology and biochemistry* Metabolism, growth and cultivation of bacteria, structure of bacteria as related to function Laboratory emphasizes the cultivation and manipulation of bactena as research tools for the study of comparative physiology and molecular biology

610. Genetics of Bacteria and Bacteriophage (2-0 or 2-6) Cr 2 or 4 S *Prereq Course in microbiology and genetics* Advanced course in genetics and molecular biology of bactena and bactenal viruses Laboratory is a continuation of Bact 600 laboratory

612. Current Topics in Parasite Ecology, Evolution, and Systematics. (Zool 612)

615. Molecular Immunology (B B 615) See *Biochemistry and Biophysics*

620 Molecular Genetics. (Gen 620) See *Genetics*

626. Advanced Food Microbiology (F Tch 626) See *Food Technology*

685. Advanced Soil Biochemistry (Agron 685) See *Agronomy*

690. Advanced Topics Cr 1 to 5 each time elected *Prereq Permission of instructor* Selected topics of current interest

698. Seminar in Molecular, Cellular, and Development Biology. (MCDB 698) See *Molecular, Cellular, and Development Biology*

699 Research

***Course offered at the Gulf Coast Research Laboratory.**

452G Marine Microbiology. Cr 5 SS Offered for undergraduate credit through a cooperative arrangement with Iowa State University *Prereq 8 semester credits in microbiology* A general course designed to introduce the microbiology and advanced biology student to the role of microorganisms in the over-all ecology of the oceans and estuaries

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*Written permission of the coordinator of the Gulf Coast Research Laboratory, 201 Bessey Hall, Iowa State University, Ames, Iowa 50011, is prerequisite to all courses offered at the Laboratory.

Courses taught in the Department of Botany:

Bot 406. Principles of Mycology
Bot 500 Field Biology of Freshwater Algae
Bot 641, 642. General Mycology.
Bot 679. Light and Scanning Electron Microscopy
Bot 681. Transmission Electron Microscopy

Military Science

Norman L Rue, Head of Department

Professor: Rue

Associate Professor: Devens

Assistant Professor: Campbell

Instructor: Brewster, Hildebrand

Iowa State University graduates who successfully complete the military science program receive a double diploma an academic degree and a commission as a Second Lieutenant in the U S Army A commission as an Army officer affords the opportunity to pursue a profession in one or several of the 388 different jobs held by Army officers Students who complete the military science program and do not desire to serve on active duty may request to serve as an officer in an Army Reserve or National Guard unit This is an outstanding and well-paying part-time job Regardless of the method of service, officers in today's Army can be proud to know that they are doing their share in the defense of the United States of America

The ISU military science program is divided into two segments, the basic course and the advanced course. The basic course (courses numbered 101-210) is designed primarily for freshmen and sophomores. No military obligation is incurred by a person participating in the basic course The basic course is designed to be informative and to acquaint students with the military as a profession It formulates a basis of information upon which students decide if they wish to enter the advanced course, and it provides the military science cadre an opportunity to evaluate persons to determine if they have the leadership and managerial potential to become Army officers The advanced course is structured to provide the necessary preparation to qualify as a basic commissioned officer Further schooling of about 3 months qualifies the officer in a particular military skill and branch of the Army

Students may enter the advanced course several ways (1) They may elect to progress from the basic to the advanced course (2) They may apply for and complete a 6-week basic camp at Fort Knox, Kentucky Students attend this camp without obligation and receive pay for their participation Attendance at the camp is accepted in lieu of the basic course (3) Veterans may elect to use their active duty as a substitute for the basic course (4) Junior ROTC graduates that have successfully completed JROTC in high school may elect to enter MS III (5) Selected college students may enroll in e special 90-hour contact program that will provide entrance into the Advanced Program (6) College students that are members of the National Guard or Army Reserve may join the Simultaneous Membership Program (SMP) and enter MS III

Persons entering the advanced course must execute a contract with the Army Obligations under the terms of the contract will vary (1) persons who become part-time officers in the U S Army Reserve or the National Guard have a 90-120 day active duty obligation for further training as an officer, which is followed by part-time service ranging from 4 to 8 years, (2) nonscholarship students assigned to active duty have a 3-year obligation, (3) scholarship students have a 4-year active duty obligation Officers serving on active duty may complete their total military commitment of 6 years through part-time service with the U S Army Reserve, National Guard or may elect stand-by service A student who willfully fails to observe the contract terms may be called to active duty in an enlisted grade

Other students may enroll in a particular course, subject to the approval of the Professor of Military Science

Financial assistance is available to military science students as follows:

1 All military science texts, laboratory materials, and uniforms are provided at no expense to the student A small deposit is required for the issue of the uniform. This deposit is returned upon satisfactory turn-in of the uniform.

2 High school seniors may compete for 4-year Army ROTC scholarships, which pay for tuition, books, laboratory fees, supplies, and provide an allowance of $100 per month during the normal school year

3 Military Science I students are eligible to compete for 3-year Army ROTC scholarships,

which pay for tuition, books, laboratory fees, supplies, and provide an allowance of $100 per month during the normal school year

4. Military Science II students, students attending the basic camp, and entering veterans are eligible to apply for 2-year Army ROTC scholarships, which pay for tuition, books, laboratory fees, supplies, and provide an allowance of $100 per month during the normal school year

5 Military Science IV students are eligible to apply for 1-year Army ROTC scholarships, which pay for tuition, books, laboratory fees, supplies, and provide an allowance of $100 per month during the normal school year

6 All nonscholarship advanced course students receive a $100 allowance per month while in the advanced course, up to $2,000 Scholarship students in the advanced course continue to receive their $100 monthly allowance

7 Students attending basic or advanced camp are provided room and board, paid travel, and receive a salary for their participation

Each student executes a contract with the Army upon acceptance of a scholarship, but may voluntarily and honorably terminate participation in the scholarship program at any time prior to entry into the advanced course Also see *Officer Education Programs*

Leadership laboratory is offered separately for credit in each of the years of military science (MS I-IV) It is optional for basic course students but is required for scholarship and contract students in the advanced course Leadership laboratory affords the military science student the opportunity to become acquainted with military skills and apply leadership principles learned in the classroom

All students in the advanced course attend a 6-week camp at Fort Lewis, Washington, after either their Military Science third or fourth year This camp is a leadership laboratory in which students can learn and practice leadership, view and utilize military hardware and equipment not available at ISU, and receive Army Branch information that is invaluable to seniors requesting assignments to a specific branch

Persons interested in military science should visit the department which is located in the Armory or call the professor of military science

Basic Course

These courses are nonobligatory and are primarily for freshman and sophomore students No more than 10 credits in 100- and 200-level courses may be applied toward graduation

101. Introduction to Military Science. (1-0) Cr 1 F S Organization and mission of the Department of Defense and ROTC, with emphasis on the Army, both nationally and at ISU Activities available in Army ROTC Designed to give students sufficient information to make an informed decision about continuing in Army ROTC

102. The United States Defense Establishment. (1-0) Cr 1 S Role and organization of the national defense establishment as an instrument of policy in providing for national security Interrelationships of the Department of Defense, State Department, Joint Chiefs of Staff, and the services subordinate to the Department of Defense, history, mission, and organization of the services Introduction to military grade structure and basic unit organization.

101A, 102A, 201A, 202A. Basic Leadership Laboratory (0-2) Cr 1 Basic military training related to developing confidence, character, and leadership The team approach in task and mission accomplishment; hands-on training of various military items and equipment Cadet staff organization and functions, military reviews and ceremonies, close order drill, leadership reaction, rappelling, land navigation, patrolling, cross country skiing, first aid, and participation in the Army Physical Fitness Test Locations to include Camp Dodge, Holst State Forest, Pammel Woods (ISU Campus), and the ISU Armory

201. American Military History. (2-0) Cr 2 F The development of American military institutions, policies, experiences, and traditions in peace and war from colonial times Emphasis on the role of the Army and the application of the principles of war

202. Map Reading and Land Navigation. (2-0) Cr 2 S Characteristics and features of the earth's land mass and application of methods of conducting navigation on land by use of topographical maps, compasses, and aerial photographs Military map symbols and their practical application

210. Practicum in Basic Military Skills. Cr 6 SS *Prereq Permission of department head* Basic military skills for students with no prior military or ROTC training Involves attendance at the six-week Army ROTC Basic Camp, Fort Knox, Kentucky Completion enables students to enroll in the Advanced Course and is taken in lieu of 101, 102, 201 and 202 Offered on a satisfactory-fail basis only

Advanced Course

301 Small Unit Tactics. (3-0) Cr 3 F *Prereq Completion of the basic course* Organization, composition, and missions of operational elements Principles of offensive and defensive combat operations with emphasis on the attack, withdrawal, retrograde, delay, patrolling, combat intelligence, tactical communications, and the troop leading procedure

302. Methods of Instructing Military Skills. (3-0) Cr 3 S *Prereq Completion of the basic course* Development of effective military writing techniques, basic educational psychology, oral presentation techniques, use of training aids, and lesson planning Students prepare presentations incorporating all phases of effective instruction on fundamental individual combat, survival, navigational and conditioning skills to prepare them for advance camp and duties as junior officers

301A, 302A, 401A, 402A. Advanced Leadership Laboratory. (0-2) Cr 1 *Prereq Completion of basic course* On-the-job training and evaluation provided by the ROTC cadre Developing training programs, structuring laboratories, presenting classes planning various events, and accepting responsibility for the leadership labs The Swim test, Army Physical Fitness Test and the diagnostic map test required of candidates for a commission

310, 410. Field Training Exercise (FTX) (0-2) Cr 1 *Prereq Completion of basic course* An annual military exercise that requires approximately 30 hours of planning, participation, and follow-up plus ROTC cadre evaluation Designed primarily for the advanced ROTC cadets in preparation for being commissioned as officers in the U S Army Actual military conditions are simulated, detailed instruction in both weapons training and execution of a simulated Operation Order in accomplishing a specific military mission Conducted as a weekend problem at Camp Dodge

401. The Military Team. (3-0) Cr 3 F *Prereq Completion of the basic course* Organization and operational concepts of the military staff, military units, and organizational structures within the Army division Combat operations and their various elements, with emphasis on planning and coordination

402. Seminar: The Professional Officer (3-0) Cr 3 S *Prereq Completion of the basic course* Management, leadership, and professionalism, management tools, practices, theories, and principles; leadership principles, traits, and application, and introduction to military justice, administration and logistics

Molecular, Cellular, and Developmental Biology

(Interdepartmental Major)

S Bishop, Chair, Supervisory Committee

Supervisory Comittee: G C Brown, J Horowitz, M H Stromer

Undergraduate Study

A special program in molecular, cellular, and developmental biology is not offered for the baccalaureate. Undergraduates wishing to prepare for graduate study in molecular, cellular, and developmental biology should elect courses in botany, genetics, microbiology, and zoology, mathematics through calculus, chemistry through organic, and one year of physics Zool 325 or Bot 444 are recommended to qualified undergraduates desiring an introduction to this area

Graduate Study

Work is offered for the degrees Master of Science and Doctor of Philosophy with major in molecular, cellular, and developmental biology in several cooperating departments Animal Science, Biochemistry and Biophysics, Botany Food Technology, Genetics, Microbiology, and Zoology

Facilities and qualified faculty are available in these departments for conducting fundamental research in the three focal areas of the program structure and function of muscle, mechanisms of information storage and transfer; cell interactions and membranes Ongoing research involves studies with viral, prokaryotic, and eukaryotic systems

Students majoring in molecular, cellular, and developmental biology will become affiliated with a department and choose a major professor from the participating faculty in that department All Ph D students take a core curriculum consisting of the following courses one year of biochemistry (B B 404, 405 or B B 501, 502) molecular genetics (Gen 620 or Micro 610), cell biology (B B 526 or Zool 528), developmental biology (B B 675, Gen 619, Zool 534 or Zool 631) and seminar in MCDB (MCDB 698) M S students take the above core but may delete either the molecular genetics, cell biology, or developmental biology complement Additional course work is selected to meet departmentl requirements and to satisfy individual student research interests, courses may be chosen from those listed below The foreign language requirement is determined by the student's major department

All graduate students are required to teach as part of their training for an advanced degree

Courses for Graduate Students, major or minor

508. Vertebrate Virology. (Micro 508) See *Microbiology*

509. Plant Virology. (PP SW 509) See *Plant Pathology Seed and Weed Sciences*

512. Plant Growth Regulation. (Bot 512) See *Botany*

526. Cell Biology of Selected Eukaryotic Cell Systems (B B 526) See *Biochemistry and Biophysics*

528. Cellular Growth and Regulation. (Zool 528) See *Zoology*

529. Fine Structure of Plant Cells. (Bot 529) See *Botany*

534. Molecular Development and Differentiation. (Zool 534) See *Zoology*.

535. Laboratory in Cytogenetics. (Gen 535) See *Genetics*

547. Biological Applications of Microscopy (F Tch 547) See *Food Technology*

560. Evolutionary Genetics. (Gen 560) See *Genetics*

574. Microscopy. (B B 574) See *Biochemistry and Biophysics*

575. Laboratory in Microscopy. (B B 575) See *Biochemistry and Biophysics*.

590. Special Topics. Cr Arr

600. Comparative Anatomy and Physiology of Bacteria. (Micro 600) See *Microbiology*

610 Genetics of Bacteria and Bacteriophage. (Micro 610) See *Microbiology*

615. Molecular Immunology. (B B 615) See *Biochemistry and Biophysics*

619 Developmental Genetics. (Gen 619) See *Genetics*

620 Molecular Genetics (Gen 620) See *Genetics*

621 Somatic Cell Genetics. (Gen 621) See *Genetics*

630 Current Topics in the Cellular and Molecular Biology of Animal Systems. (Zool 630) See *Zoology*

631 Advanced Developmental Biology (Zool 6312) See *Zoology*

632 Cellular Regulation. (Zool 632) See *Zoology*

645. Biochemistry of Metabolic Regulation. (B B 645) See *Biochemistry and Biophysics*

670 Molecular Biology of Muscle (An S/B B 670) See *Animal Science*

675. Nucleic acids and Gene Regulation. (B B 675) See *Biochemistry and Biophysics*

679 Light and Scanning Electron Microscopy (Bot 679) See *Botany*

680. X-ray Microanalysis Using Scanning Electron Microscopy (Bot 680) See *Botany*

681 Transmission Electron Microscopy. (Bot 681) See *Botany*

698. Seminar in Molecular, Cellular, and Developmental Biology (B B 698, Bot 698, Gen 698, Micro 698, Zool 698) (1-0) Cr 1 F S Student and faculty presentations

699 Research

Music

Arthur G Swift, Head of Department

Professors: Bleyle, Burkhalter, Swift, von Grabow, White

Emeritus Professor: Niemack

Associate Professors: Barnum, Bjurstrom, David, Koupal, Messenger, Molison, Reynolds, Woods

Assistant Professors: Christensen, Darlington, Dickson, Haug, McKinney, Ransom, Saral, Schilling, Snyder, Tabbat

Instructors: Prater, Simonson, Stuart

Undergraduate Study

The Department of Music maintains a philosophy of education that draws its goals from the larger purposes of liberal arts education as defined in the statement of mission of the College of Sciences and Humanities

The department seeks to make music an integral part of all students' lives, so that they may find their places within the continually evolving musical tradition

To this end the department provides a comprehensive education through music including

1) The development of aesthetic sensitivity and the broadening of the aesthetic environment.

2) The development of intellectual understanding in music

3) The development of skills: performance, visual and aural analysis, teaching and composition

4) The development of environments which stimulate and encourage creativity.

5) The development of verbal and nonverbal communicative abilities

This comprehensive education in music prepares the student for life-long growth in the musical arts and includes activities reflecting the general university commitments to teaching, creative and scholarly activities, and service

The program of the music department is twofold

(1) To provide opportunities for any student to develop an understanding and appreciation of music as part of a liberal education Courses in music literature, theory, and areas of performance are available to the general student

(2) To provide a 4-year course of professional studies to students who wish to prepare for careers in teaching, performance, composition, and graduate studies in music or related areas

The Department of Music is a full member of the National Association of Schools of Music

Bachelor of Arts — Music Major

For the undergraduate curriculum in sciences and humanities, major in music, leading to the degree Bachelor of Arts, see *Sciences and Humanities, Curriculum*

Candidates for the degree Bachelor of Arts with a music major will normally complete 48 credits in the following courses Required 119, 120, 219, 230, 231, 319, 330, 331, 383, 384 Electives 290, 301, 324, 325, 350, 351, 352, 353, 354, 356, 360, 361, 362, 419, 430, 440, 448, 471, 472, 473, 474, 475, 490, participation in music ensembles

Bachelor of Arts students whose chief professional interest lies in research are encouraged to minor in foreign languages and literatures, history, literature, or philosophy

Bachelor of Music

For the undergraduate curriculum in music, leading to the degree Bachelor of Music, see *Sciences and Humanities, Curriculum*

Candidates for the Bachelor of Music will complete the following requirements

46	General education
0 5	Library
46	Music core
34-44	Music major (Students must select one of the following areas of concentration history and literature, music education, organ, piano, string instruments, theory-composition, voice, and wind or percussion instrument)

General Requirements

Audition and Placement Requirements. To be accepted as a music major, the student must demonstrate an appropriate level of performance as well as potential in at least one performing medium. In addition, a student must satisfactorily complete placement examinations in music theory and keyboard skills, which will be administered to all applicants The placement examinations will be given by members of the departmental faculty during summer orientation, the week preceding the opening of classes for fall semester, or by appointment Students should request these examinations in the Department of Music office before deciding on a major in music.

Seminars and Recitals. All music majors enrolled for applied music courses will attend a weekly 1-hour seminar in their areas and departmental recitals each semester

Continuation Examination. To be approved for continuation as a music major on the junior level, a student must pass a continuation examination taken normally at the end of the fourth semester Before taking this examination, the student must have passed the departmental piano and ear-training proficiency examinations To pass the continuation examination the student must display acceptable solo ability and performance techniques in at least one of the applied areas The examination also includes a review of academic standing and discussion, with the student, of the implications

Graduation Proficiency. To be recommended for graduation, a music student should demonstrate to the music faculty mature acquaintance with performance styles, technique, and repertoire All music majors will participate in departmental recitals to the satisfaction of the department Candidates for the Bachelor of Music degree will present a graduation recital

Graduate Study

Courses open for graduate minor credit are. 430, 440, 471, 472, 473, 474, 475

Courses Primarily for Undergraduate Students

19. Applied Music: Preparatory. (½-0) Cr 0 F S SS *Prereq Audition, permission of instructor and department head* Applied music for nonuniversity students Available on a limited basis, depending upon teaching loads of faculty See 119 for letter designations for various instruments Fee

100 Fundamentals of Music. (1-2) Cr 2 F S SS *Prereq Ability to read elementary musical notation* Notation, recognition, execution and analysis of scales, intervals, triads, and rhythm, key signatures, time signatures, transposition

102. Introduction to Music Literature I. (3-0) Cr 3 F S SS Expansion of the music listening experiences of the general student through greater awareness of differences in techniques of listening, performance media, and materials of the art Introduction to the components of music, form, and historical chronology via listening Student need not be able to perform or read music Open to non-majors only

103. Introduction to Music Literature II. (3-0) Cr 3 S *Prereq Music 102* Continuation of music listening experiences of the general student through directed listening and discussion-analysis Study of instrumental and vocal compositions for solo, chamber, and large ensemble media Emphasis on stylistic differences among composers and musical periods, Western and Non-Western Student need not be able to perform or read music Open to non-majors only

*111. Wind Ensemble/Symphony Band. (0-3) Cr 1 each time taken F S *Prereq Open to all students who qualify by audition* Emphasis on significant extended compositions for wind and percussion instruments Performances include three formal concerts on campus and the annual tour

*112 Concert Band. (0-2) Cr 1 each time taken F S *Prereq Open to all students who have performed on a wind or percussion instrument in high school band or orchestra* Repertoire includes the broad spectrum of band music A concert is presented each semester.

*113. Jazz Ensemble. (0-1) Cr 1 each time taken F S *Prereq Audition, permission of instructor.* Designed to explore various styles and trends in contemporary jazz

*114. Marching Band. (0-5) Cr 1 each time taken F. *Prereq. Permission of instructor, open to instrumentalists who have performed on a wind or percussion instrument in high school band or orchestra* Presentation of pregame and halftime shows at each home and one away football game Previous marching band experience not required

118. Applied Music: Nonmajors. (½-0 to 1-0) Cr 1 or 2 each time taken F.S.SS *Prereq. Audition, permission of instructor* Applied music for the general student. Will not satisfy applied music requirements for music majors See 119 for letter designation for various instruments

119, 219, 319, 419. Applied Music: Majors. (½-2 or 1-2) Cr 1 to 3 each time taken F S.SS. *Prereq Audition, permission of instructor; restricted to music majors* Minimum weekly practice of 5 hours per credit is expected Weekly seminar required Fee
A. Voice
B Piano
C. Organ
D Strings
E. Carillon
F Woodwinds
G Brass
I Percussion
K. Harpsichord

120. Introduction to Music Listening. (3-0) Cr 3 F *Prereq: Music major classification* Directed studies via aural analysis for music majors with emphasis on the materials of music, form and aesthetic issues Introduction to style and literature of the major performance media in context of historical chronology Fundamentals of score reading and performance terminology

127, 128. Class Study in Piano I. (0-2) Cr 1 each F S *Prereq 127 Audition, permission of instructor, 128. 127* 127 Major scales, beginning harmonization and transposition, sightreading, repertoire 128 Harmonic minor scales, harmonization, transposition, sightreading, repertoire

130. Introduction to Music Theory. (0-2) Cr 1 F *Prereq Music placement examination* Designed for students who wish to enroll in Music 230 but who show a need for basic aural-perceptual skills as demonstrated by performance on a placement test Intensive training in sightsinging, ear-training, and related aural skills

***131 Cardinal Keynote Singers.** (0-2) Cr 1 each time taken F S *Prereq Two semesters experience in one of the following 141, 151, 161, 171* Small mixed chorus featuring various forms of popular music Performances on and off campus

133. Basic Voice Techniques. (0-2) Cr 1 F S *Prereq Permission of instructor* Class study in voice Techniques of vocal production respiration, phonation, resonation, articulation, and performance

***141. University Chorus.** (0-3) Cr 1 each time taken F S *Prereq Open to all students by audition* Campus concerts each semester Rehearsals three times a week

***146. Summer Band.** (0-2) Credit 5 each time taken SS *Prereq Open to all students who have performed on a wind or percussion instrument in band or orchestra* One concert presented in SS

***151. Oratorio Chorus.** (0-4) Cr 1 each time taken F S *Prereq Open to all students by audition.* Concerts with ISU Symphony Orchestra and performances in conjunction with International Orchestra Festival Rehearsals three times weekly

***156. Summer Chorus.** (0-2) Cr 5 each time taken SS Open to students, staff, and community

***161. Iowa State Singers.** (0-5) Cr 1 each time taken F S *Prereq Open to all students by audition* Campus concerts, annual spring tour, and performances in conjunction with International Orchestra Festival Rehearsals five times weekly

***171. Chamber Singers.** (0-2) Cr 1 each time taken F S *Prereq Open to all students by audition* Several appearances annually by a select group capable of advanced study, performing music suitable to small ensemble, madrigals through modern

***181. Symphony Orchestra.** (0-2) Cr 1 each time taken F S *Prereq. Open to all students by audition* Reading, preparation, and performance of standard repertoire Three or four concerts annually plus occasional off-campus appearances.

***186. Summer Orchestra.** (0-2) Cr 5 each time taken SS Open to students, staff, and community

219. Applied Music: Majors. (See 119)

227. Class Study in Piano II. (0-2) Cr 1 each time taken F S. *Prereq 128 or audition and permission of instructor* Scales, arpeggios, cadences, harmonization, transposition, sightreading, repertoire

228. Sightreading and Scorereading. (0-2 or 0-3) Cr 1-2 each time taken. S. *Prereq. 227 or audition and permission of instructor* Techniques and skills of reading keyboard, vocal, orchestral, and chamber music scores at the piano

230, 231. Basic Materials of Music. (3-2) Cr 4 each Yr *Prereq. 230. Placement examination, 231 230. 230* Brief review of fundamentals. Harmonic and melodic materials of the common practice period Application of these materials in sightsinging, ear-training, keyboard, analysis, and writing Techniques of harmonization and nonharmonic tones 231 Modulation, chromatic harmony, smaller elements of formal structure, analysis, orchestration, and creative work

290. Special Problems. Cr var F S SS *Prereq Permission of instructor, A through F 12 credits in music, approval of department head, H approval of department head*
A. Education
B Theory
C Composition
D History
E Literature
F Applied Music
H Honors

301. Opera Studio. (1-3) Cr 1 to 3 each time taken F S *Prereq Permission of instructor* Interpretation and coaching of selected opera scenes and chamber operas, including informal and public presentations

318. Applied Music: Nonmajors. (½-0 or 1-0) Cr 1 or 2 each time taken F S SS *Prereq 118, permission of instructor* Advanced applied music for the general student See 119 for letter designation Fee

319. Applied Music: Majors. (See 119)

321 Advanced Ensemble. (3-0) Cr 1 F S *Prereq Advanced proficiency and performing ability, permission of director and department head* Performance in ensembles that demand high proficiency Open to a limited number of undergraduate and graduate students
A Voice
B Piano
C Organ
D Strings
E Musica Antiqua
F Woodwinds
G Brass
I Percussion
J Mixed

324. English and Italian Diction for Singing. (2-0) Cr 2 Alt F , offered 1982 *Prereq Credit or classification in 118A or 119A.* The international phonetic alphabet and its application to correct pronunciation of English and Italian in singing

325. French and German Diction for Singing. (2-0) Cr 2 Alt S , offered 1983 *Prereq Credit or classification in 118A or 119A* The international phonetic alphabet and its application to correct pronunciation of French and German in singing

330, 331. Advanced Materials of Music. (3-2) Cr 4 each Yr *Prereq 330 231, 331 330* Analysis of music from a variety of periods with emphasis on music of the late nineteenth and twentieth centuries, homophonic and contrapuntal forms, orchestration Application of techniques and concepts to aural perception and creative work

350. Instrumental Techniques. Strings. (0-4) Cr 2 F Techniques and skills required for teaching of instruments Examination of materials for school use For the instrumental music specialist

351 Instrumental Techniques: Clarinet, Flute, Saxophone. (1-2) Cr 2 S Techniques and skills required for teaching of instruments Examination of materials for school use For the instrumental music specialist

352. Instrumental Techniques: Oboe, Bassoon. (0-2) Cr 1 F Techniques and skills required for teaching of instruments Examination of materials for school use For the instrumental music specialist

353. Instrumental Techniques: Trumpet, French Horn. (0-2) Cr 1 S Techniques and skills required for teaching of instruments Examination of materials for school use For the instrumental music specialist

354. Instrumental Techniques: Trombone; Baritone, Tuba. (0-2) Cr 1 F Techniques and skills required for teaching of instruments Examination of materials for school use For the instrumental music specialist

355. Instrumental Techniques: Percussion. (0-2) Cr 1 S Techniques and skills required for teaching of instruments. Examination of materials for school use For the instrumental music specialist

356. Instrument Maintenance and Repair. (0-2) Cr 1 F Techniques and skills required for basic maintenance and repair of instruments Examination of commercial repair methods and facilities For the instrumental music specialist

360. Vocal Pedagogy. (2-0) Cr 2 S *Prereq: 319A or vocal proficiency examination* Physical, acoustical, and musical properties of the vocal instrument, including a survey of important texts and articles on singing and voice production

361. Conducting I. (1-2) Cr 2 F *Prereq 232* Introduction to conducting, score reading and analysis Conveying musical ideas through appropriate gestures Leadership role of the conductor

362. Conducting II. (1-2) Cr 2 S *Prereq 361* Section A Choral techniques Style and interpretation of choral repertoire. Section B. Instrumental techniques Advanced baton technique Score preparation Specific problems of large instrumental ensembles

364. Music in Early Childhood Education. (3-1) Cr 3 S *Prereq C D 225 or El Ed 345.* Objectives, teaching approaches, and materials for guiding musical growth ages 3 to 5 The musical characteristics of children, the musical environment, and the application of rhythm instruments, folk songs and instruments, and movement in conceptual teaching and learning Observation of and participation with, preschool children

365. Music in Elementary Education. (3-1) Cr 3 F SS *Prereq C D 129, El Ed 345* Comprehensive approaches to teaching music in the elementary school Movement, singing, classroom instruments and materials reviewed Integration of the language arts movement, and music through the procedures and techniques of Orff, Kodaly, and Laban Music teaching skills for the classroom teacher Observation of, and participation with, primary school children

383, 384. History of Music. (3-0) Cr 3 each Yr *Prereq 383. 102 or 120, 384 383 recommended* History of the stylistic and cultural development of music 383 Middle Ages through Baroque 384 Classical through contemporary music

430 Seminar in Analysis for Performance (3-0) Cr 3 Alt F , offered 1981 *Prereq 331* Analysis and performance of selected works appropriate to student's performance medium Examination of structural, rhythmic, harmonic, and textural aspects of the music selected Literature will vary according to the needs of the class

440 Seminar in Music Theory. (3-0) Cr 3 S *Prereq 331* Various topics in music theory including counterpoint, arranging, pedagogy, and psychology of music Content will vary Contact the Music Department for the current year offering

448. Electronic Music Synthesis. (3-0) Cr 3 Alt F , offered 1982 *Prereq 331* Introduction to techniques of electronic music production, recording, mixing Emphasis on applications to music education and creative work

464 Band Administration, Materials, and Methods (0-2) Cr 1 F Administrative techniques and instructional materials appropriate for teaching instrumental music in the elementary and the high school Procedures for directing marching band and jazz band programs in the secondary schools Instrumental rehearsal techniques for the elementary and secondary band and orchestra

465. Choral Materials and Methods. (0-2) Cr 1 F Instructional materials and methods appropriate for teaching choral music in the secondary school Procedures for designing and directing school musical productions and jazz and swing choirs Choral rehearsal techniques for the secondary school

466. Music Education: Philosophy, Research, Methodology K-12. (4-1) Cr 4 F *Prereq 360 or 362* Philosophy and history of music education Review of current music education research Objectives, curriculum, methods, and instructional materials appropriate for teaching music in the elementary and secondary schools Background and activities in comprehensive musicianship, Orff improvisation, Dalcroze eurythmics, Kodaly approach to reading and writing music, individualized instruction in the junior high school, and related arts programs in the high school Program development, budgets, scheduling Information regarding music in special education, open education, and urban education Observation of, and participation with, primary and secondary school classes

471. Seminar in Music History (2-0) Cr 2 F Various topics in music history including keyboard music, choral music, and chamber music Content will vary Contact the Music Department for the current year offering

472. History of American Music. (3-0) Cr 3 Alt F , offered 1982 *Prereq 9 credits from music, American literature, American history, art history* Serious and popular currents that have influenced development in American music and its relation to transcendentalism, mass culture, and other intellectual, social, and cultural trends in the history of America.

473. Music of the Baroque Era. (3-0) Cr 3 Alt S , offered 1983 *Prereq 383, 384* Detailed survey of

instrumental, vocal, choral, and keyboard music from 1600 to 1780

474 **Music of the Classical Era.** (3-0) Cr 3 Alt F, offered 1981 *Prereq: 383, 384* Detailed survey of instrumental, vocal, choral and keyboard music from 1780 to 1825

475. **Music of the Romantic Era.** (3-0) Cr 3 Alt S, offered 1982 *Prereq 383, 384* Detailed survey of instrumental, vocal, choral and keyboard music from 1825 to 1910

490 **Independent Study.** Cr var F S SS *Prereq. Permission of instructor, A through F 12 credits in music, approval of department head*

A Education
B Theory
C Composition
D History
E Literature
F Applied Music
H Honors

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

590 **Special Topics.** Cr var F S SS *Prereq Permission of instructor, approval of department head*

A Education
B Theory
C Composition
D History
E Literature
F Applied Music

Naval Science

Head of Department

Professor: Shewchuk

Instructors: Bailey, Black, Chambers, Huber, Rau

The function of the Navy and Marine Corps officer education programs is to provide, by a permanent system of education in essential naval science and other academic subjects at civil education institutions, a source from which qualified officers may be available for the Navy and the Marine Corps and their reserve components

Students who enter the Navy and Marine Corps officer education programs may apply for either of two programs, the *NROTC scholarship program* (full scholarship, which includes books, tuition, laboratory fees, uniform, and $100 per month), or the *college program* (nonscholarship, limited financial assistance) Applicants for the scholarship program are selected through comprehensive nationwide competitive procedures Applicants for the college program are selected by the Professor of Naval Science from among students already in attendance at or selected for admission by the University This program only involves financial assistance of $1,000 for each of the last two academic years NROTC students pursue their studies like other students except that they meet certain requirements that will prepare them to serve as officers after graduation A scholarship program student incurs a 4-year military obligation as a commissioned officer after graduation, a college program student incurs a 3-year obligation If a scholarship student fails to earn a degree, or if a commission is not tendered (for other than physical reasons), the student then incurs a 2-year obligation in an enlisted grade. This obligation is not incurred until the junior year has commenced Information is available from the Professor of Naval Science, Iowa State University, concerning application, financial assistance, career opportunities, and active duty obligation Also see *Officer Education Programs*

While in the program, students will participate in summer at-sea training cruises with pay, and will be expected to take part in extracurricular activities that will help them decide which field of the Navy or Marine Corps they wish to enter These activities include three cruises for scholarship and one for nonscholarship students, several student societies, and indoctrination trips to a naval air station, a submarine base, and a Marine Corps base

Undergraduate Study

Naval science courses are primarily for those students in the NROTC program However, other university students may also enroll in naval science courses

All students enrolled in the NROTC program must fulfill the following requirements

1 N S 111, 112, 211, 212, 311, 312, 411, 412 Marine option students will substitute N S 311M, 312M, 411M, and 412M for the 300 and 400 series listed above

2 All NROTC students must complete one semester of a major Indo-European or Asian language prior to graduation * All NROTC students not enrolled in engineering or approved science majors are required to take a course in American military affairs and national security policy Engineering and approved science majors are encouraged to undertake these courses to fulfill electives within the matrix of their major

3 All Navy option scholarship students must complete Math 165, 166 or 175, 176 by the end of the sophomore year, Phys 221, 222 by the end of the junior year Additionally those majoring in liberal arts or other non-technical curricula will include at least two science/engineering courses as electives

4 In addition to the normal naval science courses, all NROTC students are required to participate in laboratory periods that supplement the various academic courses, emphasize human relations principles, teach basic military formations, movements, commands, courtesies, and honors, and provide practice in unit leadership

5 NROTC students are not required to major in naval science Navy option scholarship students are expected to major in engineering or approved sciences Other degree programs may be pursued if complementary to the naval profession and approved by the head of the department Nonscholarship Navy option students and Marine Corps option students may pursue any major leading to a bachelor's degree

In addition to completing all naval science courses, students majoring in naval science must take the following courses Chem 163, 163L, 164, Com S 111, 112, geography, 3 credits, Hist 390, Math 165, 166 (175, 176), Phys 221, 222, Pol S 251, 358, Psych 101, Stat 101

Marine Corps option students majoring in naval science will take the 300M- or 400M-series courses in lieu of the 300 and 400 series naval science courses

For basic undergraduate curriculum requirements, see *Sciences and Humanities, Curriculum*, or *Engineering, Curricula*.

*Scholarship requirements.

Courses Primarily for Undergraduate Students

111. **Introduction to Naval Science.** (3-2) Cr 3 F Introduction to the organization, regulations, and capabilities of the Navy, with emphasis on mission and principal warfare components Course also covers seamanship, shiphandling, and human resource management

112. **Naval Ship Systems I (Engineering).** (3-2) Cr 3 S Familianzation with types, structure, and purpose of naval ships Ship construction, stability, and damage control, ship propulsion and power systems

211. **Naval Ship Systems II.** (3-2) Cr 3 F Introduction to the theory and principles of operation of naval weapon systems Includes coverage of types of weapons and fire control systems, capabilities and limitations, theory of target acquisition, identification and tracking, basics of Naval Ordnance

212 **Seapower and Maritime Affairs.** (3-2) Cr 3 S Development of concept of seapower including the Merchant Marine, role of various warfare components of the Navy in supporting the Navy's mission, implementation of seapower as an instrument of national policy, a comparative study of U S and Soviet naval strategies

311, 312. **Navigation and Naval Operations.** (3-2) Cr 3 each 311 F, 312 S 311 Study of ship navigation, movement and work, math analysis, spherical triangulation and practical work including piloting, rules of the road, electronic navigation and introduction to celestial navigation 312 Celestial navigation, analysis and maneuvering of tactical formations

311M **Evolution of Warfare.** (3-2) Cr 4 Alt F, offered 1981 Evolution of warfare from 3500 B C to contemporary times, analysis of the impact of historical precedents on modern military thought and action, emphasis on the historical development of military tactics, strategy, and technology

312M **Naval Science Laboratory.** (0-2) Cr R Alt S, offered 1982 Open only to NROTC Marine Option Midshipmen

411 **Leadership and Management I** (3-2) Cr 3 F Expenential approach to learning the principles of leadership and management Skills are developed in the areas of communication, counseling, control, direction, management and leadership through active guided participation in case studies, experiential exercises, and situational problems

412 **Leadership and Management II.** (3-2) Cr 3 S Basic background concerning the duties and responsibilities of the junior naval officer and division officer in the areas of human resources management, personnel management, material management, and the administration of discipline Preparation for responsibilities encountered immediately upon commissioning

411M **Evolution of United States Amphibious Warfare** (3-2) Cr 4 Alt F, offered 1982 Defines the concept of amphibious operations, origins, traces its development since the American Revolution

412M **Naval Science Laboratory.** (0-2) Cr R Alt S, offered 1981 Open only to NROTC Marine Option Midshipmen

Nuclear Engineering

George Bumet, Chair of Department

Professors: Bumet, Danofsky, Roberts, Rohach, Wechsler

Associate Professors: Barcus, Hendrickson, Ma, Sabri, Valfells

Undergraduate Study

For the undergraduate curriculum in nuclear engineering leading to the degree Bachelor of Science, see *College of Engineering, Curricula.*

Nuclear engineering is that branch of engineering associated with the release, control, and utilization of all types of energy from nuclear souces. Nuclear engineers are responsible for research, development, design, construction, operation, and management of systems for the controlled release of nuclear energy and the applications of radiation for medical, agricultural, and industrial use.

Industry, government, and universities employ nuclear engineers in areas such as reactor analysis, radioisotope applications, computer applications, energy transfer, radiation protection, safety analysis, materials selection and development, and instrumentation and control Work may involve economics, legal processes, regulation and inspection, construction, manufacturing and sales, and management

Nuclear engineering requires a broad foundation in mathematics and the physical sciences, and draws upon many other technical disciplines. The curriculum includes courses in mathematics, physics, chemistry, electrical theory, solid and fluid mechanics, heat transfer, thermodynamics, radiation safety, nuclear reactor theory, and nuclear fuels and wastes, as well as technical and sociohumanistic electives In the senior year, nuclear systems design provides the student with experience in application of the knowledge gained in the technical courses. Computers are used extensively in design and problem solving Oral and written communications skills are emphasized

Graduate Study

The department offers work for the degrees Master of Science, Master of Engineering, and Doctor of Philosophy with a major in nuclear engineering Minor work in nuclear engineering is offered to students taking major work in other departments.

Students may prepare for graduate work in nuclear engineering by pursuing undergraduate programs in engineering or in the physical sciences. It is recommended that students contemplating graduate studies in nuclear engineering include courses in modern physics, heat transfer, thermodynamics, chemistry, and mathematics (beyond differential equations) as part of their undergraduate preparation

Admission to the EAC/ABET-accredited Master of Engineering program is restricted to those students having a bachelor's degree from an EAC/ABET-accredited engineering curriculum or the equivalent

For the degree Doctor of Philosophy, a foreign language may be required by the student's program of study committee

Because materials are an important aspect of nuclear engineering, there is an interdisciplinary arrangement with the Department of Materials Science and Engineering. Nuclear engineering students interested in materials aspects of nuclear energy technology are encouraged to consider the following courses. M S E 375, 401, 402, 520, 522, 523, 551, 552, and 650

The department also participates in the interdepartmental minor programs of Energy Systems Engineering, Water Resources, and Technology and Social Change. (See Index)

Open to graduate students for minor credit only 331, 361, 401, 411, 441, 444, 451, 471, 481, 482, 484.

Courses Primarily for Undergraduate Students

100. Technical Lecture. (1-0) Cr R S Orientation in the field of nuclear engineering

211. Fundamentals of Nuclear Engineering. (2-3) Cr 3 F S. *Prereq: Credit or classification in Phys 221, Com S 172* Fusion, fission, and isotopic energy sources Radioactivity and reaction rates Mass and energy balances. Formulation of problems in nuclear engineering and analysis of experimental data. Radiation measurement and control Practical experience in reactor operations

221. Radiation and Radioactivity. (3-0) Cr 3 S *Prereq Credit or classification in 211, Math 265* Atomic and nuclear structure Isotopes Alpha, beta, and gamma decay Nuclear reactions Fission and fusion processes Radioactivity Interaction of radiation with matter Cross sections.

298, 398, 498. Cooperative Education. Required of all cooperative students *Prereq: Permission of department administration* 298 Work periods for students with sophomore standing in a regularly established program 398. Work periods for juniors 498 Work periods for seniors Students must register for these courses prior to commencing each work period

301. Nuclear Power: Technical Concerns and Social Issues. (Soc 301) (2-0) Cr 2 F The relationship between nuclear energy and society is examined, from both a technical viewpoint, including energy conversion methods and fuel cycles, and a social viewpoint, including political and social costs of energy policies and weapons proliferation

331. Fission Reactor Analysis. (4-0) Cr 4 F *Prereq 221, credit or classification in Math 267* Neutron moderation and diffusion Theory of homogeneous and heterogeneous reactors Reactor kinetics and control Fission product buildup and poisoning Fuel burnup Numerical techniques

331L. Laboratory in Reactor Analysis. (0-2) Cr 1 F *Prereq Classification in 331* Laboratory to accompany 331 331L required of undergraduate nuclear engineering students

361. Nuclear Engineering Laboratory. (2-3) Cr 3 S *Prereq 221, credit or classification in Math 267* Principles of nuclear radiation detection and measurement Counting statistics Detection system performance parameters Data reduction and analysis Problems involving reactor engineering measurements

401 Nuclear Power Engineering. (3-0) Cr 3 F *Prereq Math 266, Phys 222* Atomic structure, radioactivity, nuclear reactions, neutron interactions Basic reactor theory, kinetics and control Energy generation and removal Nuclear reactor systems Regulations Not acceptable for credit for a nuclear engineering degree

411. Radiation Protection and Dosimetry (2-2) Cr 3 S *Prereq 221* Radiation units Somatic and genetic effects of radiation Natural and man-made radiation sources Standards of radiation protection

441 Safety and Control of Nuclear Systems. (3-0) Cr 3 S *Prereq 331* Nuclear reactor dynamics and control Safety analysis Assessment of magnitudes and consequences of nuclear incidents Reactor siting, containment, and engineered safeguards. Regulations

444. Time Behavior of Nuclear Reactor Systems. (3-0) Cr 3. S. *Prereq. 331.* Development of time-dependent nuclear reactor models, space-independent kinetic equations, reactivity feedback, and linear system stability Nuclear power plant dynamics

451. Nuclear Fuel Cycles, Processes, and Management. (3-0) Cr 3 F *Prereq 331, I E 304, M S E 375.* Ore processing Uranium enrichment Fuel fabrication Spent fuel reprocessing Radioactive waste handling and disposal In-core fuel management Nuclear safeguards. Economic analysis

461. Nuclear Systems Laboratory. (0-3) Cr 1 F S *Prereq: 361, credit or classification in M E 436.* Laboratory measurements of process variables in nuclear reactor systems. Performance evaluation of system components Non-destructive examination

471. Fusion Reactor Systems. (3-0) Cr 3. S *Prereq 331* The technological requirements of power production by nuclear fusion Plasma fueling and recovery, fuel cycles and control Energy conversion, neutronics, and blanket design. Magnetic and laser fusion systems. Fission-fusion hybrids Safety aspects

481. Nuclear Power System Analysis and Design I. (2-3) Cr 3 F *Prereq: 331, credit or classification in M E 436* Nuclear reactor core and component analysis and design Nuclear reactor core thermal and hydraulic analysis and design Critical heat flux and hot spot factors. Applications of numerical techniques Iterative techniques in design.

482. Nuclear Power System Analysis and Design II (1-6) Cr 3. S. *Prereq. 451, 481, credit or classification in 441* Integration into systems design Shielding design Thermodynamic aspects of nuclear power plants Kinetics and control Plant stability and transient behavior Fuel burnup and fuel management Fuel costs Over-all safety assessment.

484. Nuclear Radiation Engineering. (3-0) Cr 3 S *Prereq. 221.* Nuclear engineering applications other than those oriented towards large scale power production Isotopic power sources Radiation gauging Biomedical, agricultural, and chemical industry uses of radiation Neutron radiography and activation analysis

490. Independent Study. Cr var Independent study in any phase of nuclear engineering
H Honors

491, 492. Seminar. (1-0) Cr R Yr *Prereq Senior classification*

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

521. Nuclear Physics for Engineers. (3-0) Cr 3 F *Prereq Math 266, Phys 222* Introduction to relativity quantum theory Fundamental particles and nuclear models Nuclear reactions and decay Isotopes and radiation Fission and fusion reactions

531. Nuclear Reactor Theory I (4-0) Cr 4 F *Prereq 331, 521* Neutron moderation and diffusion Theory of homogeneous and heterogeneous reactors Introduction to perturbation and transport theories

532 Nuclear Reactor Theory II. (3-2) Cr 4 S *Prereq 531* Space-independent kinetic equations, time-dependent reactivity, reactivity feedback and linear system stability, nuclear power plant models Fuel burnup, fission product buildup and poisoning Reactor control

535. Nuclear Radiation Shielding. (3-0) Cr 3 Alt F , offered 1982 *Prereq 531, 581* Analysis of shielding systems for protection against gamma radiation and neutrons Kernel techniques Heat generation in shields Shield optimization Charged particle shielding

541 Nuclear Safety Evaluation Methods. (3-0) Cr 3 S *Prereq 441* Methods for quantifying accident probabilities, fault tree analysis, reliability assessment and simulation techniques

543. Energy Systems Enginering. (E E 543, M E 543) See *Mechanical Engineering*

551. Radiation Effects on Materials I: Fundamental Radiation Damage. (M S E 551) (3-0) Cr 3 F *Prereq M S E 270 or 271 or 375* Characteristics of radiation environments Scattering and absorption cross sections Determination of neutron flux and spectrum Defects in materials. Experimental observations of radiation damage Effects of annealing and impurities

552. Radiation Effects on Materials II: Application to Nuclear Systems. (M S E 552) (3-0) Cr 3 S *Prereq 551.* Defect clusters, voids, and bubbles Radiation hardening and embrittlement. Radiation effects on pressure vessel steels, fuel cladding, and core components Radiation-induced swelling Fuel restructuring and densification Radiation effects on materials for fusion reactors Radiation effects on non-metals, including semiconductors and polymers

555. Processing of Nuclear Fuels and Wastes. (3-0) Cr 3. Alt F , offered 1981 *Prereq. 451.* Nuclear fuel resource assessment. Ore processing. Isotope separation methods Chemical reprocessing of nuclear fuels. Radioactive wastes processing and management. Environmental safeguards Nonproliferation impact.

561. Nuclear Radiation Laboratory. (1-3) Cr 2 F *Prereq: Credit or classification in 521.* Statistical methods in radiation detection. Nuclear electronics Data reduction and analysis. Applications to engineering problems

571. Nuclear Fusion Theory. (3-0) Cr 3. Alt. F , offered 1982 *Prereq: 471, 521* Principles of controlled thermonuclear fusion reactions, thermonuclear plasma production, confinement, heating, and diagnostics Impurity effects and fusion energy release.

581. Nuclear Reactor Thermal Systems. (3-0) Cr 3 S *Prereq: 331, 441* Applications of nuclear power utilization. Power cycles, heat transfer, thermodynamics and fluid dynamic aspects of reactor systems

582. **Nuclear Reactor Engineering Systems.** (3-0) Cr 3 F *Prereq 481 or 581* Thermal and mechanical limitations of the nuclear steam supply system Burnout correlations Thermal, irradiation, and mechanical effects upon stress analysis of reactor components

585. **Nuclear Power Plant System Design.** (1-4) Cr 3. S *Prereq. Credit or classification in 532, 582.* Overall design of nuclear power plants A group project with individual component or system design and integration into the total project. Component and material selection Control, shielding, siting, licensing, engineered safeguards, and economic considerations

590. **Special Topics.** Cr. var Topics of special interest in nuclear engineering

Courses for Graduate Students, major or minor

621. **Advanced Nuclear Theory.** (3-0) Cr 3 Alt F, offered 1981 *Prereq: 521* Advanced theory of nuclear cross sections Nuclear models Theoretical and experimental considerations

631, 632. **Advanced Nuclear Reactor Theory.** (3-0) Cr 3 each Alt Yr, offered 1982-83 *Prereq: 631. 532, 632. 631* Advanced topics in nuclear reactor theory. Perturbation theory Synthesis methods Variational techniques Transport theory Monte Carlo methods

642 **Advanced Nuclear Reactor Dynamics.** (4-0) Cr 4 Alt S, offered 1982 *Prereq: 532* Space-dependent reactor dynamics. Non-linear system stability Application of random noise techniques to reactor systems Rossi-alpha and variance to mean experiments

650. **Nuclear Reactor Fuels.** (M S E 650) (2-0) Cr 2 Alt F, offered 1981 *Prereq 552 or M S E 375* Physical, chemical, nuclear, thermal, and mechanical properties of metallic, ceramic, and liquid fuels for nuclear reactors. Fuel cycles and fuel element design in thermal and fast reactors Fuel fabrication. Behavior of fission products Fuel restructuring and densification Implications for safety and economics of nuclear reactors

654. **Nuclear Fuel Management.** (3-0) Cr 3 Alt S, offered 1982 *Prereq: 451, 532* Methodologies in nuclear fuel management. Advanced numerical techniques Optimization techniques in nuclear fuel management

661 **Advanced Nuclear Engineering Laboratory.** (2-3) Cr 3 S *Prereq Credit or classification in 532, 561,* 582 Performance evaluation of nuclear systems using standard and experimental measurement methods

671 **Advanced Nuclear Fusion Theory.** (3-0) Cr 3 Alt S, offered 1983 *Prereq 571.* Plasma, particle transport theory and equations Important plasma devices in experiments, fundamental scaling laws, radiation energy losses, plasma stability and fusion reactor design concepts

681 **Advanced Nuclear Engineering Analysis.** (2-2) Cr 3 Alt S, offered 1982 *Prereq 532, 582* Analysis of new concepts in nuclear engineering. Application of advanced computational techniques

690 **Advanced Topics.** Cr var

695. **Advanced Seminar.** (1-0) Cr R F S Presentations and discussions of advances and problems in contemporary nuclear engineering.

699 Research.

Officer Education Programs

Iowa State University offers programs for the preparation of officers for the Army, Navy, and Air Force.

The purpose of these programs is to provide reserve and short-term active duty officers, and longer-term regular career officers. All three services require a period of active duty and prepare students for possible careers in military service. Consequently, Iowa State University views these Officer Education Programs as ones that may prepare students for a military career.

Financial assistance grants are made to all students enrolled in advanced ROTC programs, and are described under *Financial Aids* Scholarships are also available for all services as outlined in the section on Financial Aids.

ROTC is recognized as a subject matter area of specialization The following categories of credit allocation are recognized.

I A student can major in Navy ROTC in the College of Sciences and Humanities, applying 24 credits toward the major

II. In colleges where minors are part of the curriculum, 15 credits of advanced ROTC may be applied toward the minor Nine credits of basic ROTC may be applied toward the elective requirement

III If a student does not select ROTC as a major or minor, ROTC credits may, at the discretion of the college and the department, be applied toward the elective requirement

IV In the College of Engineering a student may elect the Officer Education specialization in Engineering Operations In the curriculum up to 14 hours of ROTC credits can normally be applied toward the elective group requirements See *Engineering Operations, Curriculum.*

For specific courses and programs see also *Air Force Aerospace Studies, Military Science,* and *Naval Science*

Pest Management

Larry P Pedigo, Chairman, Advisory Committee

Professors: McNabb, Moorman, Pearce, Pedigo, Staniforth, Tipton

Associate Professors: Domoto, Hall

Assistant Professor: Mertins

The pest management program is designed for students with a career interest in the science and technology of pest control Students in the program conduct interdisciplinary studies with plant diseases, insects, weeds, and other pests, emphasizing the development of control systems are are ecologically and economically sound. The interdisciplinary nature of the program is reflected in the departmental sponsors — Agronomy; Animal Ecology; Biochemistry and Biophysics; Botany; Plant Pathology, Seed, and Weed Sciences; Entomology; Forestry; and Horticulture.

Pest management is an undergraduate secondary major that may be taken only in conjunction with a primary major For example, the student may wish to take a primary major in agronomy, forestry, entomology, or some other life science and use elective credits to satisfy the requirements of the pest management major. Students educated in pest management may find employment opportunities with governmental agencies (state and federal), agricultural chemical companies, food-processing firms, consulting agencies, timber companies, and other concerns which produce, process, and market the nation's food and fiber.

Students wishing to enroll in the pest management curriculum must register with the chairman of the advisory committee. After consultation with the chairman, a pest management adviser will be assigned, depending on the interests of the student. The student should indicate interest in pest management as early as possible in order that requirements of the program be effectively integrated with those of the primary major.

Courses Primary for Undergraduate Students

216. **Weed Identification and Management.** (PP SW 216) See *Plant Pathology, Seed, and Weed Sciences*

225. **Formulation and Application of Pesticides.** (Hort 225) See *Horticulture*

340. **Chemical Use in Crop Production and Soil Management.** (Agron 340) See *Agronomy.*

376. **Fundamentals of Entomology and Pest Management.** (Ent 376) See *Entomology.*

407. **Principles of Plant Pathology.** (PP SW 407) See *Plant Pathology, Seed, and Weed Sciences*

416. **Forest Pest Management.** (PP SW 416) See *Plant Pathology, Seed, and Weed Sciences*

416. **Weed Control with Herbicides.** (PP SW 418) See *Plant Pathology, Seed, and Weed Sciences.*

490. **Independent Study.** Cr 1 to 3 *Prereq 3 credits in pest management, permission of instructor and written plan of study approved by pest management curriculum chairman*

491. **Pest Management Experience.** Cr 2 to 4 *Prereq. 6 credits in pest management; permission of instructor* Practical experience (internship) in management of plant diseases, insect populations, weeds, and other pests Diagnosis, problem assessment, and control procedures are emphasized For majors and advanced students

499. **Pest Management Seminar.** Cr 1 F *Prereq. Senior classification* Current topics of interest to pest management

Philosophy

John W Elrod, Chairman of Department

Professors: Klemke, Van Iten

Emeritus Professor: Shideler

Associate Professors: Elrod, Hollenbach, Hollinger, Kupfer, Robinson, Solomon

Assistant Professors: Kline, Leguard, Smith

Undergraduate Study

See *Sciences and Humanities, Curriculum,* for the undergraduate curriculum in sciences and humanities, with major in philosophy, leading to the degree Bachelor of Arts.

The major in philosophy offers study in the important ideas, values, and ways of thinking that underlie cultural, social, and political processes, and that direct the specialized search for knowledge. Philosophical study broadens the student's educational experience and facilitates more effective participation in the human community.

An undergraduate major in philosophy should have a broad background in the sciences and humanities. The major program includes both a core and electives to provide a thorough acquaintance with the history of philosophy and further concentration in historical and systematic issues. An undergraduate major in philosophy can prepare the student for graduate work in philosophy, and also for further study in law, history, theology, religion, political science, social and political theory, or literature.

The degree program in philosophy requires a minimum of 24 credits in the core program and, for those not concentrating in religious studies, 6 credits of electives chosen from the remaining courses listed in the 300 or 400 levels

The following courses compose the basic core program of the department from which 24 credits shall be chosen

a Introduction. 201 (required)

b Ethics 230 (required)

c Logic. 207 (required)

d Aesthetics, philosophy of law, political philosophy, philosophy of religion and philosophy of science, one course required Choose from 332, 335, 340, 350, 380, or 381

e History two courses required, choose from 310, 311, 312 and 313 (must be taken for 4 credits each)

f Seminars 430, 460, and 470 (two seminars required)

For those philosophy majors desiring a more enriched preparation in philosophy, Intensive Studies in Philosophy is offered Completion of this program will be formally recognized and serve as an addition to recommendation to further study Admission to this program requires the permission of the adviser and the chairman of the department For further information regarding the details of this program, see the department chairman

Religious Studies

A major in philosophy may be combined with a concentration in religious studies Requirements for this option are the same as above with the following exceptions

a Philosophy of Religion, 350, is required

b The two required seminars must be Religious Studies 465 and 475

For course descriptions and other programs in religious studes see *Religious Studies*

Graduate Study

The department offers courses for graduate minor work in studies in philosophy and participates in the interdepartmental programs in General Graduate Studies and Technology and Social Change (See Index)

Courses open to graduate students for minor credit only 310, 311, 312, 313, 320, 332, 335, 340, 350, 380, 381, 430, 460, 470, 590

Courses Primarily for Undergraduate Students

†201. **Introduction to Philosophy** (3-0) Cr 3 or (3-1) Cr 4 F S SS It has been rumored that the unexamined life is not worth living Philosophy is an attempt to begin examining life by considering such questions as What makes us human? What is the world ultimately like? How should we relate to other people? Is there a god? How can we *know* anything about these questions? Understanding these kinds of questions and proposed answers to them is what this course is all about

206. Introduction to Logic and Scientific Method. (3-0) Cr 3 F S SS Introduction to the principles of reasoning and argumentation Emphasis on elementary deductive and inductive arguments and on principles of scientific method Common fallacies in reasoning Uses and abuses of language Application of the principles of logic and argumentation to contemporary issues

207. Introduction to Symbolic Logic. (3-0) Cr 3 S Introduction to fundamental logical concepts and logical symbolism Development of natural deduction through first order predicate logic with identity Development of axiomatic treatment through completeness of propositional logic Applications to arguments in ordinary English and to philosophical issues

†**230. Moral Problems in the Modern World.** (3-0) Cr 3 or (3-1) Cr 4 F S SS Contemporary moral issues abortion, euthanasia, reverse discrimination, the enforcement of morality, censorship, sexual morality, medical ethics, business ethics, etc Ethical theories and approaches to the nature of values and obligations, ethical evaluation and decision making

***310. Ancient and Medieval Philosophy.** (3-0) Cr 3 or (3-1) Cr 4 F *Prereq 201* Plato's and Aristotle's metaphysics and epistemology, related to their moral and social theory Some representative medieval philosophers such as Augustine and Aquinas, and such problems as free will and the existence of God

***311. Modern Philosophy.** (3-0) Cr 3 or (3-1) Cr 4 S *Prereq 201* Philosophy from the late Rennaissance to the late 18th Century Our beliefs about our world, ourselves, our deities, and our morals The nature of doubt and certainty, sources of knowledge and illusion

***312 19th and 20th Century Continental Philosophy** (3-0) Cr 3 or (3-1) Cr 4 F *Prereq 201* Hegel's philosophy and various responses to this philosophical position Developments in phenomenology (e g , Husserl, Heidegger, and Merleau-Ponty), existentialism (e g , Kierkegaard, Nietzsche, and Sartre), and social and political philosophy (e g , Marx and Habermas)

***313. Twentieth Century Anglo-American Philosophy** (3-0) Cr 3 or (3-1) Cr 4 S *Prereq 201* Main problems and themes of major movements in contemporary philosophy such as pragmatism, realism, common sense philosophy, logical positivism, and ordinary language philosophy Readings include key works by representatives of these positions

***320. Existentialism.** (3-0) Cr 3 or (3-1) Cr 4 F *Prereq 201* Philosophical foundations of existentialism Kierkegaard, Nietzsche, Sartre, and Heidegger Its religious, literary, and psychoanalytic expressions Dostoevsky, Tolstoy, Tillich, Buber, Marcel, Camus, Pursey, May, and Laing

***332. Philosophy of Law** (3-0) Cr 3 or (3-1) Cr 4 Alt S , offered 1982 *Prereq 201 or 230* Extent of our obligation to obey the law, what constitutes just punishment, how much of the immoral should be made illegal? Relation of these questions to major theories of law and the state Discussion of such concepts as coercion, equality, and responsibility

***335. Social and Political Philosophy** (3-0) Cr 3 or (3-1) Cr 4 F *Prereq 201* Foundations of social and political life Metaphysical and epistemological grounds in classical and recent thinkers The basis of political organization, the nature of social and political institutions, rights and authority, justice and the character of distinctly political action Original texts

***340 Aesthetics** (3-0) Cr 3 or (3-1) Cr 4 F *Prereq 201 or 230* Is liking all there is to appreciating works of art or natural beauty? We will examine our appreciative experiences, *talk* about such experiences (e g , art criticism), and what makes them *valuable* Do the different arts have common values? How are their differences important?

***350 Philosophy of Religion** (Relig 350) (3-0) Cr 3 or (3-1) Cr 4 S Prereq 201 The value and truth of religious life and belief Mystical experience, religious faith and language, arguments for God's existence, the problem of evil, miracles, and religion and morality Historical and contemporary readings from both the western and eastern traditions

***380 Philosophy of Science.** (3-0) Cr 3 or (3-1) Cr 4 F *Prereq 201* Introduction to the philosophy of science A variety of basic problems common to the natural and social sciences the nature of explanation, the structure of theories, the unity of science, and the distinction between science and non-science

***381. Philosophy of the Social and Behavioral Sciences** (3-0) Cr 3 or (3-1) Cr 4 S *Prereq 201 or 6 credits in the social sciences* An examination of conflicting approaches to the study of human behavior, as represented by the social and behavioral sciences Conflicts between different approaches against the backdrop of conflicting theories of scientific method Similarities and differences between the social and natural sciences, as well as among the various social and behavioral sciences Assumptions about the nature of human beings, values and societies, the value-neutrality of the social sciences and the ideological dimensions of the policy sciences Selections from social scientists and philosophers

430. Seminar: Value Theory. (3-0) Cr 3 each time taken, maximum of 6 credits S *Prereq 230* Theoretical and normative issues in ethics, aesthetics, religious thought, or political philosophy Topics vary each time offered

460 Seminar: Epistemology and Metaphysics. (3-0) Cr 3 each time taken, maximum of 6 credits Alt F , offered 1981 *Prereq 201 and at least one course in the history of philosophy* Issues in epistemology and metaphysics Topics vary each time offered

470. Seminar: Philosophical Systems. (3-0) Cr 3 each time taken, maximum 6 credits Alt F , offered 1982 *Prereq 201 and at least one course in the history of philosophy* Focus upon philosophical systems analysis of several philosophers forming a tradition or school, or one philosopher who offers a comprehensive system Topics vary each time offered

490. Independent Study. Cr 2 to 4 each time taken *Prereq. 6 credits in philosophy, permission of instructor approval of chairman* Guided reading and research on special topics selected to meet needs of advanced students
H Honors

Courses Primarily for Graduate Students for minor credit, open to qualified undergraduates

590. Special Topics in Philosophy. Cr 2 to 4 each time taken *Prereq Permission of instructor, 9 credits in philosophy*
A History of Philosophy
B Epistemology and Metaphysics
C Value Theory
D Logic and Philosophy of Science

†Optional fourth credit with permission of instructor entails guided research or other complementary study

*Optional fourth credit entails guided research or other complementary study.

Physical Education and Leisure Studies

Barbara E Forker, Head of Department

Professors: Forker, Menze, Nichols, Schneider Toman

Emeritus Professors: Grant, Schmidt, Timm

Associate Professors: Conover, Cooney, Gagnier, Hutchison, Kiyoguchi, Mathes, Pease, Puhl, Rupnow, Sutherland, Wood

Assistant Professors: Dean Anderson, Beran, Bergan, Duncan, Flatten, Gearhart, Keenan, McCullough, McDonald, McLean, Metzler, Murdoch, Orr, Schabel, Steel, Symons

Instructors: Dale Anderson, L Anderson, Bosso Corrigan, Greenlee, Groseth, Harrison, Hieber, Hitsman, Houglum, Jensen, Kern, Kramer, Lee, Lundholm, McEachran, McGinn, D O'Connell, J O'Connell, Oing, Pak, Pejsach, Phipps, Pisciotta, Randall, Renko, Roberts, Schultz, Schumacher, Townsend, Urick, Van Horn, White, Wishart

Undergraduate Study

Health Studies. The introductory courses in health studies offer opportunities for learning experiences in personal and community health, and emergency health care Students interested in teaching may qualify to teach health education (see *College of Education, Requirements of Areas of Specialization in Teacher Education)* Students seeking preparation in the health education area should contact the department for program advisement

Dance. Course work in dance provides opportunities for students to develop an understanding and appreciation of dance as part of a liberal education Those interested in teaching dance and physical education in the public schools may major in physical education with an area of specialization in dance An individualized noncertification program in dance is also available through the Department of

Physical Education and Leisure Studies. A concentration area in dance is available for students majoring in other departments or colleges.

Leisure Studies. For undergraduate curriculum in leisure studies leading to the degree Bachelor of Arts, see *College of Education, Curricula*. The program prepares the student to enter the leisure studies (recreation and parks) field in local, state, and national public or private agencies serving leisure interests and needs of general and special populations. The leisure studies major combines a core of leisure studies course offerings with a pandisciplinary component consisting of selected courses from cognate areas For those students interested in certain aspects of the total leisure studies field such as outdoor recreation or therapeutic recreation, additional competence may be obtained through selection of appropriate electives in combination with course offerings in the major program.

Physical Education. For undergraduate curriculum in physical education leading to the degree Bachelor of Science, see *College of Education, Curricula*. The curriculum in physical education has three facets: the general education requirement, a required core, and the option of a certification or a noncertification program.

The certification option provides a program of studies for students who wish to become certified to teach physical education in the secondary schools. Additionally, a program is provided for students who wish to become authorized to teach physical education in kindergarten and grades one through twelve Specialization opportunities are available in the areas of athletic training, coaching, dance, and health. To be accepted into the teacher education program, students must be approved by the departmental and the College of Education Teacher Education Committees

The noncertification option is planned for students interested in an interdisciplinary approach to the study of human movement The noncertification option provides preparation for careers associated with recreation agencies, media, institutions, industries, and research laboratories. Students choosing the noncertification option devise an individualized program of study tailored to meet individual needs and interests.

Endorsement to Coach Interscholastic Athletics. The State Department of Public Instruction has provided for the endorsement of certified teachers for the coaching of athletic teams in schools. The endorsement is intended for teachers who hold majors in subjects other than physical education who wish to coach interscholastic teams. The endorsement does *not* lead to certification to teach physical education. For requirements of the program, leading to the coaching endorsement, see *College of Education, Requirements for Areas of Specialization*.

Basic Activity Instruction Program. The department offers a wide selection of beginning, intermediate, and advanced courses in the areas of aquatics, dance, and sports. These courses are designed to serve general education purposes for all students.

Graduate Study

The department offers work for the degree Master of Science with major in physical education and minor work to students taking major work in other departments

The normal prerequisite to major graduate work is the satisfactory completion of a curriculum essentially equivalent to that required of undergraduate students in physical education at this University However, it is possible for students to qualify for graduate study even though undergraduate preparation has been in a related area.

A student in the graduate program may select either a thesis or non-thesis option. Specific information about the requirements for either degree option is available from the departmental office

Courses open to graduate students for minor credit only: L S 355, 453, 494, P E 355, 370, 390, 392, 455, 475

Courses Primarily for Undergraduate Students

Athletics (Ath)

99. Athletic Conditioning. Cr 0 S Conditioning program for sports participants Open to all students.

***100. Intercollegiate Athletics.** Cr 1 in any one semester. Limited to 1 credit per year to a maximum of 4 F.S *Prereq: Permission of head coach*

A. Baseball (men)
B Basketball (men)
C Basketball (women)
D Cross Country (men)
E. Cross Country (women)
F Football (men)
G Golf (men)
I Gymnastics (men)
J Gymnastics (women)
K Softball (women)
L. Swimming/Diving (men)
M Swimming/Diving (women)
N Tennis (men)
O Tennis (women)
P Track and Field (men)
Q Track and Field (women)
R Volleyball (women)
S Wrestling (men)
T Golf (women)

*Credit in a sport section of Ath 100 and a beginning level skill-activity course in the same sport may not be applied toward graduation.

Leisure Studies (L S)

100. Orientation to Leisure Studies. (1-0) R F S Professional preparation for the leisure services field Open to leisure studies majors only Offered on a satisfactory-fail basis only

201. Leisure and Recreation: Concepts and Services. (3-0) Cr 3 F S. Concepts of leisure and recreation, historical development; the park and recreation movement in the United States, the professional field of service

283. Introduction to Professional Services. (1-3) Cr 2. F.S. *Prereq: 100, credit or classification in 201. Open to leisure studies majors only; advance reservation required* Orientation, visitation, and observation of leisure services agencies and programs. Demonstration and practice of basic leadership techniques. Offered on a satisfactory-fail basis only Fee for field trips.

350. Leadership, Services, and Programs. (2-4) Cr 4. F S. *Prereq: 201, Soc 264* Principles and practices in park and recreation leadership, program development, services, and community organization for leisure. Fee for field trips.

351. Outdoor Recreation: Concepts and Practices. (2-0) Cr. 2. F S. *Prereq: 201.* Introduction to concepts and practices of outdoor recreation including historical perspectives, governmental and private involvements, research, participant behavior, legislation, and economics. Fee for field trips.

355. Dimensions of Recreation in the Campus Community. (3-0) Cr 3. F.S. *Prereq: 350.* Basic concepts in organization, administration, and program planning for recreation in the campus community.

383. Practicum in Leisure Services. (0-6) Cr. 2. F.S.SS. *Prereq: 283, 350. Open to leisure studies majors only; advance reservation required.* Observation and practice in established leisure programs and services of selected agencies

394. Leisure and Recreation in Relation to Special Populations. (2-0) Cr. 2. F.S. *Prereq: 201.* Concepts of leisure and recreation in relation to ill, disabled, and other special populations; historical perspectives, current status and concerns. Fee for field trips.

451. Methods in Outdoor Recreation. (0-6) Cr. 2. S. *Prereq: 351.* Skills, methods, and educational practices in program planning and in communicating values of the outdoor environment. Fee for field trips.

453. Administration of Leisure Services. (3-2) Cr 4. F.S *Prereq: 350, 383.* Principles and practices of administering leisure programs and services.

483. Internship in Leisure Services. Cr 9 or 12. F S.SS *Prereq: 383, senior classification. Open to leisure studies majors only; advance reservation required.* Fulltime work experience combined with field study in established leisure programs and services of selected agencies. Credit to correlate with length of assignment

490. Independent Study. Cr var *Prereq: Advance permission.*

A. Topics in various aspects of laisure and recreation
H Honors

494. Therapeutic Recreation Processes and Services. (1-3) Cr 2 S *Prereq: 394.* Applications of recreation concepts and leadership principles in serving ill, disabled, and other special populations. Nature and scope of services, settings, and agencies. Fee for field trips.

495. Seminar in Leisure Studies. Cr .5-1. *Prereq: Senior classification.* Offered on a satisfactory-fail basis only

Courses Primarily for Graduate Students, open to qualified undergraduates

580. Theory and Philosophy of Leisure. (3-0) Cr 3 *Prereq: 2 courses in leisure studies or related areas.* Theoretical and philosophical development of the leisure concept with application to the professional field of service. Historical development of theory and philosophy

582. Strategies for Communication in Outdoor Recreation. (0-5) Cr. 2. *Prereq: 451.* Advanced skills, methods, and educational practices in program planning and in communicating values of the outdoor environment.

Health Studies (H S)

105. First Aid and Emergency Care. (1-2) Cr. 2. F.S. Discussion and application of the basic techniques of administering first aid ARC certification available.

110. Personal and Consumer Health. (3-0) Cr 3. F S. Physical, mental, and social aspects of health as a basis for understanding and preventing health problems False and misleading advertising and effects of cultists and fadists on consumer health. Study of legislation and agencies concerned with consumer protection and health insurance.

215. Drug Education. (2-0) Cr 2. Use and abuse of mood modifying substances in contemporary society Includes study of tobacco, alcohol, and other druga.

250. Human Diseases: Causes and Prevention. (2-0) Cr 2. *Prereq. 110.* Discussion of disease process and ill-health in the twentieth century. Emphasis on epidemiology and prevention.

***275. Health Education in the Elementary School.** (2-0) Cr 2 An overview of school health services, healthful school living, and health instruction for teachers at the elementary level

305. Instructor's First Aid. (0-2) Cr. 1 *Prereq: Current American Red Cross Standard First Aid and Personal Safety Certification.* Discussion and practice of skills needed to teach first aid and cardiopulmonary resuscitation. ARC certification available.

310. Community and Public Health. (2-0) Cr. 2. *Prereq: 110.* Introduction to community health problems, programs of prevention, environmental health agencies, and health services. Study of local, state, and national community health agencies, their purposes and functions.

***375. Teaching-Learning Process in Health Education.** (3-0) Cr. 3. *Prereq: 105, 110, 215.* Principles, methods, materials, and resources involved in the teaching of health. Includes organization and development of the health education curriculum. (K-12)

390. Administration of the School Health Program. (3-0) Cr. 3. *Prererq: 310.* History and legal basis of school health programs. Procedures for developing, organizing, administering, and evaluating a modern program of health services, healthful school living, and

health instruction Includes school-community relationships

417 **Supervised Teaching in Health Education in the Secondary School.** Cr Var F.S. *Prereq: 375. Advance registration required* Offered on a satisfactory-fail basis only

418. **Supervised Teaching in Health Education in the Elementary School.** Cr Var F S *Prereq. 375 Advance registration required.* Offered on a satisfactory-fail basis only

488. **Directed Field Experience in Health Education.** Cr 1 to 3 *Prereq 375* Supervised experience in health education Offered on a satisfactory-fail basis only

490 **Independent Study.** Cr Var F S *Advance permission required*

*Credit for both 275 and 375 may not be applied toward graduation.

Dance (Dance)

115. **American Ballroom Dance.** *(0-2) Cr 5 F S Instruction and practice in foxtrot, waltz, swing, and selected fad dances

116. **Latin and Contemporary Social Dance.** *(0-2) Cr 5 F S Instruction and practice in cha cha, rhumba, tango, and selected contemporary dances

117 **Folk Dance.** *(0-2) Cr 5 F S. Instruction and practice in various international folk dances

118. **Square Dance.** *(0-2) Cr .5 F S Instruction and practice in the fundamentals of square dance

120. **Modern Dance I.** (0-3) Cr 1 F S Introduction and practice of basic dance concepts, including preparatory techniques and guided creativity problems

130 **Ballet I.** *(0-3) Cr 5 F S Introduction to the basic skills, vocabulary, and tradition of ballet with concentration on control and proper alignment

131 **Ballet II.** *(0-3) Cr 5 F S. *Prereq. Dance 130.* Designed to expand the vocabulary and proficiency in beginning ballet techniques.

132. **Ballet III.** (0-3) Cr 1 *Prereq Dance 131* Concentration on technical proficiency at the intermediate level of a classical movement vocabulary

135. **Jazz I.** *(0-3) Cr 5 F S Introduction to the modern jazz style with concentration on isolation and syncopation

136. **Jazz II** *(0-3) Cr 5 *Prereq Dance 135* Dance concepts within the jazz idiom Instruction in extended movement sequences including turns and aerial work

137 **Introduction to Tap Dance.** *(0-3) Cr 5 Instruction and practice in basic tap technique Routines in military tap, buck rhythms, soft shoe, and waltz clog Terminology, stage directions, choreography and performing are emphasized

190 **Fundamentals of Modern Dance.** *(0-3) Cr 5 F S Introduction and practice in the basic fundamentals of modern dance as a form of movement education Open to physical education majors only

199. **Dance Continuum.** Cr 5 to 2 each time taken, maximum of 6 credits F S *Prereq. Permission of instructor, advance registration required* Continued instruction and practice in either modern dance, recreational dance, ballet, jazz and /or compositional skills Offered on a satisfactory-fail basis only

220 **Modern Dance Composition I** (1-3) Cr 2 S *Prereq 120 or 190* Theory and practice of the creative skills involved in solo and small group composition

222. **Modern Dance II.** (0-3) Cr 1 F S *Prereq 120 or 190* Instruction in intermediate dance techniques, including aerial work and extended combinations

223. **Modern Dance III.** (0-3) Cr 1 F S. *Prereq 222* Practice in advanced dance techniques, emphasizing strength, balance, and endurance Some repertory work

224. **Concert and Theatre Dance.** (0-3) Cr 5 to 2, maximum of 6 credits F S *Prereq. By audition only* Choreography, rehearsal, and performance in campus dance concerts and/or musical theatre productions Offered on a satisfactory-fail basis only

270 **Dance Appreciation.** (2-0) Cr 2 F Introduction to dance as an art form, emphasizing abilities to analyze and appreciate various dance styles. No dance experience required

320 **Sound and Movement.** (0-3) Cr 2 S *Prereq 220* Creating sounds in relation to improvised movement

*Designates 8-week classes.

Improvised accompaniment and suggestions for sound compositions

360. **History and Philosophy of Dance.** (3-0) Cr 3 Alt S , offered 1982 *Prereq 270* Study of the history of dance from early to modern times with emphasis on the theories and philosophies of contemporary modern dance, dancers, and dance educators

370 **Advanced Studies in Dance.** Cr 1 to 3 in any one semester to a maximum of 8 credits F S *Prereq 2 credits in dance Advance registration required* Designed to meet special interests and talents of students to include both group and independent study in various aspects of dance as a performing art including production, choreography, and performance

371. **Elementary Labanotation.** (2-0) Cr 2 Fundamentals of basic labanotation (movement writing) with emphasis on reading and performing notated movement scores and writing movement sequences Principles may be applied to any type of movement, but primary emphasis is on notating and reading dance composition

385. **Teaching Modern and Recreational Dance.** (1-3) Cr 2 F S *Prereq 115, 117, 190, and P E 187* Methods and techniques of teaching recreational and modern dance forms

386. **Teaching Dance Technique and Composition.** (1-3) Cr 2 Alt S , offered 1983 *Prereq 385* Teaching of dance as an expressive art form with emphasis on technique, rhythm, and the creative teaching process

490. **Independent Study.** Cr var *Prereq Advance permission* Independent study of problems or areas of interest in dance

Physical Education (P E)

101. **Swimming I.** (0-3) Cr 1 F S Basic course for beginning swimmers Emphasis on basic strokes, personal safety, and deep water skills Fee

102. **Swimming II.** (0-3) Cr 1 F S *Prereq 101 or equivalent skill* Intermediate course Emphasis on 4 basic strokes, plus back crawl and trudgen strokes Fee

103. **Swimming III** (0-3) Cr 1 F S *Prereq 102 or equivalent skill* Perfection of all strokes Emphasis on the 10 styles of swimming, plus advanced swim skills Fee

105. **Springboard Diving.** (0-3) Cr 1 F S *Prereq 102 or equivalent skill* Fee

107. **Synchronized Swimming.** (0-3) Cr 1 *Prereq 102 or equivalent skill* Fee

108. **Aquatic Fitness.** (0-3) Cr 1 *Prereq 101 or equivalent skill* Water related exercises, activities, and programs to improve physical fitness Fee

109. **Basic Skin and Scuba Diving.** (1-2) Cr 1 F S *Prereq Swimming competence* Fee

110. **Advanced Scuba Diving.** (1-2) Arr Cr 1 *Prereq 109* Fee

111. **Certified Scuba Diving.** *(1-1) Cr 5 F S *Prereq 109* Fee

112. **Scuba Assistant Instructor Training.** (0-2) Cr 1 *Prereq 111 or Scuba Diving Certification* Emphasis on skill analysis, safety skills, dive planning, teaching techniques, and legal aspects of instruction. Fee

113. **Scuba Assistant Instructor Practicum** (0-2) Cr 5 *Prereq 112 or equivalent* Supervised experience in conduct of basic scuba diving program Offered on a satisfactory-fail basis only Fee

114. **Life Saving.** (0-5) Cr 2 F S *Prereq Ability to swim 500 yards continuously of front crawl, sidestroke, and breaststroke, perform a standing and surface dive, swim underwater, and tread water for one minute Minimum age 15* Red Cross Certification Fee

115. **Water Safety Instructor.** (0-5) Cr 2 F S *Prereq. Minimum age 17, current Advanced Life Saving Certificate* Swimming and water safety skills, stroke analysis, methods of class organization and instruction, and Red Cross certification Fee

116. **Canoeing.** *(0-3) Cr .5 F S *Prereq Ability to stay afloat 10 minutes in deep water while clothed* Instruction and practice in basic strokes and skills needed for the safe handling of a canoe Fee

117. **Sailing.** *(0-3) Cr 5 F S *Prereq Swimming competence* Fee

118. **Water Polo.** *(0-3) Cr 5 *Prereq 102 or equivalent skill*

*Desginates 8-week classes.

119. **Archery I.** *(0-3) Cr 5 F S Fee

120. **Archery II.** *(0-3) Cr 5 S *Prereq. 119 or equivalent skill* Fee

122. **Badminton I.** *(0-3) Cr 5 F S

123. **Badminton II.** *(0-3) Cr 5 F S *Prereq 122 or equivalent*

125. **Baitcasting.** *(0-3) Cr 5 F S

126. **Pocket Billiards I.** *(0-2) Cr .5. F.S. Introduction to the basic strokes (stop, draw, follow) and contemporary game forms associated with pocket billiards Fee

127. **Pocket Billiards II.** *(0-2) Cr 5 F S. *Prereq. 126 or equivalent* Use of basic strokes in more advanced game forms Fee

129. **Bowling I.** *(0-2) Cr 5 F S Fee

130. **Bowling II.** *(0-2) Cr 5 F S *Prereq 129 or equivalent* Fee

132. **Fencing.** (0-3) Cr 1 F.S. Fee

135. **Golf I.** *(0-3) Cr 5. F S Beginning skills only Fee

136. **Golf II.** *(0-3) Cr 5 F S *Prereq. 135 or equivalent skill* Fee

137. **Golf III.** *(0-3) Cr 5 F S *Prereq: 136.* Emphasis on individual error correction and practice in the advanced skills of golf Study of comprehensive rules which apply to competitive play Fee

139. **Gymnastics I.** *(0-3) Cr .5. F S

140. **Gymnastics II.** *(0-3) Cr 5 F S *Prereq 139 or equivalent skill*

143. **Handball.** *(0-3) Cr 5 F S

144. **Racquetball.** *(0-3) Cr 5. F S

146. **Target Riflery.** (0-2) Cr 1 F S Fee.

148. **Snow Skiing I.** *(0-3) Cr 5 S Fee

149. **Snow Skiing II.** *(0-3) Cr 5 S *Prereq: 148 or equivalent* Fee

151 **Cross Country Skiing.** *(0-3) Cr 5. S. Fee.

153. **Ice and Figure Skating.** *(0-3) Cr .5 S Fee

155. **Ice Hockey I.** *(0-3) Cr 5 S Fee

156. **Ice Hockey II.** *(0-3) Cr 5 S *Prereq: 155 or equivalent*

156. **Tennis I.** *(0-3) Cr 5 F S SS Introduction to basic skills (forehand, backhand, service) and basic knowledge of game play Fee

159 **Tennis II.** *(0-3) Cr 5 F S SS *Prereq 158 or equivalent* Expansion of basic skills to include volley and spins Introduction to basic strategy Fee

160. **Tennis III.** *(0-3) Cr 5 F S *Prereq 159 or equivalent* Introduction to more advanced skills (lob, overhead, and spin serves) Fee

161. **Tennis IV.** *(0-3) Cr 5 F S *Prereq 160* Instruction and practice in the more advanced skills of tennis Emphasis on the use of these skills and strategy employed in effective singles and doubles play Fee

163. **Physical Fitness.** (0-3) Cr 1 F S Evaluation of fitness status Exercises, activities, and programs to improve physical fitness Relationship between physicel activity and weight control

166. **Weight Training I.** (0-3) Cr 1 F S

167. **Weight Training II.** *(0-3) Cr .5. F.S. *Prereq. 166.*

168. **Judo I.** *(0-3) Cr 5 F S

169. **Judo II.** *(0-3) Cr 5 F S *Prereq. 168*

170. **Tae Kwon Do/Karate I.** *(0-3) Cr 5. F S

171 **Tae Kwon Do/Karate II.** *(0-3) Cr 5 *Prereq. 170* Fee

172. **Self-Defense.** *(0-3) Cr 5 F S. Basic elements of self-defense

173. **Hap Ki Do/Martial Self-Defense.** *(0-3) Cr 5. F S

174. **Wrestling.** (0-3) Cr 1 F

175. **Bicycling.** *(0-3) Cr 5.

176. **Camping Skills and Techniques.** *(0-3) Cr .5. F.S. Skills in outdoor cookery, firebuilding, and orianteering Study of equipment, weather influences, protection of natural resources, and the use of native materials. Fee

177. **Horseback Riding.** *(1-2) Cr .5. F.S. *Prereq: No former experience in equitation.* Basic horseback riding, knowledge, and practice in riding skills. Fee.

178. **Basketball.** *(0-3) Cr .5.

179. **Flag Football.** *(0-3) Cr .5. F.S

180. **Softball I.** *(0-3) Cr .5. F.S.

181. Softball II. *(0-3) Cr 5 F S *Prereq 180 or equivalent skill.*

182. Volleyball I. (0-3) Cr 1 F S.

183. Volleyball II. *(0-3) Cr 5 S *Prereq 182 or equivalent skill*

186. Fundamentals of Combatives. (0-3) Cr 1 F S For physical education majors only

187. Rhythmic Aspects of Movement. (0-3) Cr 1 F S Study and practice of the rhythmic structure inherent in movement activities Physical education majors only

188. Fundamentals of Archery. *(0-3) Cr 5 F S Physical education majors only Fee

189. Fundamentals of Badminton. *(0-3) Cr 5 F S Physical education majors only

190. Fundamentals of Golf. *(0-3) Cr 5 F S Physical education majors only Fee

191. Fundamentals of Tennis *(0-3) Cr 5 F S Physical education majors only Fee

192. Fundamentals of Wrestling *(0-3) Cr 5 F Physical education majors only

193. Fundamentals of Basketball. *(0-3) Cr 5 F S Physical education majors only

194. Fundamentals of Soccer and Speedball *(0-3) Cr 5 F Physical education majors only

195. Fundamentals of Softball. *(0-3) Cr 5 F S Physical education majors only

196. Fundamentals of Track and Field. *(0-3) Cr 5 F S Physical education majors only

197 Fundamentals of Volleyball. *(0-3) Cr 5 F S Physical education majors only

198. Fundamentals of Gymnastics. (0-3) Cr 1 F S Physical education majors only

199. Fundamentals of Fitness and Conditioning. (0-3) Cr 1 F S Physical education majors only

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*Designates 8-week classes.

Professional Program Courses

201. Techniques of Baseball. (0-5) Cr 2 Fundamentals of pitching, catching, batting, baserunning, infield and outfield play Designed for the student seeking the coaching endorsement

202. Techniques of Basketball (0-5) Cr 2 Fundamentals of basket shooting, passing, ball handling, and footwork Various defensive and offensive patterns Designed for the student seeking the coaching endorsement

203. Techniques of Football (0-5) Cr 2 Fundamentals of offensive and defensive line and backfield play, forward passing and kicking skills Designed for the student seeking the coaching endorsement

209. Techniques of Track and Field. (0-5) Cr 2 Fundamentals of various track and field events included in most high school programs Designed for the student seeking the coaching endorsement

215. Officiating Baseball/Softball. (0-3) Cr 1 S Rules, rules interpretation, techniques and mechanics of officiating baseball and softball Practical experience gained through officating in the intramural program

216. Officiating Basketball. (0-3) Cr 1 F S Rules, rules interpretation, techniques and mechanics of officiating men's and women's basketball Practical experience gained through officiating in the intramural program

217 Officiating Football. (0-3) Cr 1 F Rules, rules interpetetion, techniques, and mechanics of officiating football Practical experience gained through officiating in the intramural program

218. Officiating Volleyball. (0-3) Cr 1 Rules, rules interpretation, techniques and mechanics of officiating volleyball Practical experience gained through officiating in the intramural program

219. Officiating Wrestling. (0-3) Cr 1 Rules, rules interpretation, techniques and mechanics of officiating wrestling Practical experience gained through officiating in the intramural program

***220. Athletic Training for Coaches.** (1-2) Cr 2 *Prereq Zool 156* Introduction to methods of prevention and immediate care of athletic injuries Basic information concerning health supervision of athletes, and some basic wrapping and strapping techniques for common injuries. Fee

***225. Introduction to Athletic Training.** (2-2) Cr 3 *Prereq. 163 or 199, H S 105, Zool 156* Qualifications, opportunities, preparation, and duties of athletic trainers Introduction to the establishment and operation of the athletic training room and the role of the trainer in the prevention, treatment and reconditioning of athletic injuries Practical application of basic wrapping and strapping techniques

250. Physical Education Orientation (1-0) Cr R F S Orientation to various aspects of physical education and assistance in learning how to use facilities of the university and department Offered on a satisfactory-fail basis only

260. History and Philosophy of Physical Education. (3-0) Cr 3 F S Development of physical education from Grecian to modern times

270. Perspectives of Physical Education. (0-2) Cr 1 F S Nature and scope of physical education as a profession Physical education majors only

***275. Movement Education in Elementary School Physical Education.** (2-2) Cr 3 F *Prereq C D 226* Study of movement experiences appropriate for the primary and intermediate grade child Focuses upon activities that develop physical and motor fitness and awareness of the self in relation to the environment and others Designed for physical education majors

280. Directed Field Experience in Elementary School Physical Education. (0-3) Cr 1 S *Prereq 275* Observing, planning, and facilitating movement experiences of children in an elementary school setting

***284. Elementary and Pre-school Movement Education** (2-3) Cr 3 F S *Prereq 3 credits in child development* Approaches to teaching movement skills to pre-school and elementary school age children Emphasis on planning appropriate learning environments to help children develop perceptual-motor and fundamental movement skills as well as a positive self concept Practical experience provided through participation in a children's movement education laboratory

295. Supervised Practicum in Teaching. (0-3) Cr 1 *Prereq 270* Opportunity to observe and participate as an instructional assistant in physical education classes Offered on a satisfactory-fail basis only

301. Coaching Baseball. (1-0) Cr 1 *Prereq 201 or equivalent skill, Psych 230*

302. Coaching Basketball (1-0) Cr 1 S *Prereq 202 or equivalent skill, Psych 230*

303. Coaching Football. (1-0) Cr 1 *Prereq 203 or equivalent skill, Psych 230*

304 Coaching Golf (1-3) Cr 2 Alt S, offered 1983 *Prereq 136 or equivalent skill, Psych 230*

305. Coaching Gymnastics (1-3) Cr 2 *Prereq 140 or equivalent skill, Psych 230*

306 Coaching Softball (1-3) Cr 2 *Prereq 181 or equivalent skill, Psych 230*

307 Coaching Swimming (1-3) Cr 2 *Prereq 103 or equivalent skill, Psych 230*

308. Coaching Tennis (1-3) Cr 2 Alt S, offered 1982 *Prereq 160 or equivalent skill level, Psych 230*

309 Coaching Track and Field. (1-0) Cr 1 *Prereq 209 or equivalent skill, Psych 230*

310 Coaching Volleyball (1-3) Cr 2 *Prereq 183 or equivalent skill, Psych 230*

311 Coaching Wrestling. (1-3) Cr 2 *Prereq 174 or equivalent skill, Psych 230*

312. Coaching Ice Hockey. (1-2) Cr 2 Alt S, offered 1982 *Prereq 156 or equivalent skill, Psych 230*

325. Advanced Athletic Training. (0-5) Cr 2 Alt S, offered 1982 *Prereq 225, permission of instructor* Evaluation of athletic injuries and advanced strapping and wrapping techniques Exposure to medical specialty areas as they relate to athletic training Fee

355. Kinesiology. (3-3) Cr 4 F S *Prereq Zool 156, Phys 101 or 106 or 111* The study of anatomical and mechanical phenomena which underlie human motion Includes the application of kinesiological concepts to a wide variety of physical education activities

360. Social-Psychological Aspects of Movement. (3-0) Cr 3 F,S *Prereq: Psych 101, Soc 134* Individual differences in psychological characteristics and behavior in relationship to sport and various social units and processes. Influence of personality and sociological variables on selection and performance of movement experiences

370. Principles of Motor Performance. (2-2) Cr 3 F S *Prereq. Psych 101* Factors influencing human motor performance Review of principles applicable to design of motor learning experiences in physical education.

375. Teaching Physical Education. (2-3) Cr 3 F S *Prereq 370* Principles and current practices of teaching physical education

380. Teaching Gymnastics. (0-3) Cr 1 *Prereq 198* Methods and techniques of teaching gymnastics

382. Basic Aquatic Methods. (0-3) Cr 1 *Prereq 101* Basic elements of swimming instruction, pool safety, survival and rescue techniques, and related aquatic activities Physical education majors only

384. Teaching Children's Dance. (1-3) Cr 2 S *Prereq 187, 275, Dance 190* Content, experiences, and methods of a comprehensive dance program at the elementary school level Theories and practice in guiding elementary school children in expressive movement experiences

****390. Physical Education for the Developmentally Disabled.** (1-2) Cr 2 F *Prereq Psych 230* Etiology, incidence, and characteristics of the developmentally disabled, and resulting implications for physical education Emphasis on adaptation of activities, methods, and program planning Observation opportunities available

****392. Physical Education for the Physically Disabled** (1-2) Cr 2 S *Prereq Psych 230* Organization of an adapted physical education program Study of specific disabling conditions in terms of etiology, description, and potential for movement and activity Activities and specific exercises aimed at the rehabilitation of the individual

394. Adapted Aquatics. (0-3) Cr 1. *Prereq Current water safety instructor certification.* Background information and techniques for teaching swimming to physically handicapped and mentally retarded individuals Laboratory experiences in the pool Red Cross certification Fee

****395. Adapted Physical Education.** (2-3) Cr 3 *Prereq 375* Specific disabling conditions in terms of etiology, characteristics, needs, and potential for movement experiences Techniques of assessment, prescription, adaptation of activities, methods, and program planning Laboratory experience required Physical education majors only.

402. Psychological and Administrative Issues in Interscholastic Athletics. (3-0) Cr 3 *Prereq Psych 230* Current problems and practices in coaching interscholastic athletics Organization, administration, psychological, and philosophical issues Not accepted for credit toward a major in physical education

417. Supervised Teaching in Physical Education in the Secondary School. Cr Var F S *Prereq 355, 375* Supervised teaching in the secondary schools Advance registration required Offered on a satisfactory-fail basis only

418. Supervised Teaching in Physical Education in the Elementary School. Cr Var F S *Prereq 280, 384* Supervised teaching in the elementary schools Advance registration required Offered on a satisfactory-fail basis only

425 Athletic Training Modalities and Rehabilitation (1-3) Cr 2 Alt S, offered 1983 *Prereq 225, 355, permission of instructor* Theory and technique of athletic training modalities and rehabilitation in the management of athletic injuries

455. Physiology of Exercise. (2-3) Cr 3 F S *Prereq Zool 156* Physiological basis of human performance, effects of physical activity on body functions

470. Evaluation in Physical Education. (2-3) Cr 3 F S *Prereq Senior classification* Principles underlying process of evaluation Selected test and measurement procedures and tools within the field of physical education

475. Physical Education Curriculum Design and Program Organization. (3-0) Cr 3 F S *Prereq 375* Current practices and principles applied to curriculum development (K-12) and to problems of organization and administration of instructional and extracurricular programs in physical education

486. Supervised Coaching in Interscholastic Athletics. Cr 1 to 3 *Prereq 220, 1 credit from courses P E 301-312* Advance registration required Offered on a satisfactory-fail basis only

488. Practicum in Athletic Training. Cr 1 to 4 *Prereq Permission of instructor* Experience in application of athletic training techniques under supervision of certified athletic trainers Offered on a satisfactory-fail basis only.

490. Independent Study. Cr Var Independent study of problems of areas of interest in physical education and related areas Advance permission required

A. Physical Education
B Coaching
H Honors

495. Seminar in Physical Education. (5-1) *Prereq Senior classification* Offered on a satisfactory-fail basis only

*Credit for only one in the following pairs of courses may be applied toward graduation: 220, 225; 215, 284.

**Credit for both 395 and 390 or 392 may not be applied toward graduation.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

505. Research Laboratory Techniques in Exercise Physiology. (0-3) Cr 1. *Prereq: 455 or equivalent course with basic laboratory experience.* Application and use of laboratory research equipment in exercise physiology, including operation, calibration, and use in selected situations

520 The Social Analysis of Sport. (3-0) Cr 3 *Prereq 360, Soc 134* Sociological analysis of sport with emphasis on sociological theory, sports structure, and function in modern industrialized society, the systems of sport in regard to their role structure, formal organization, and professionalization and its differentiation along social class, age, and sex

521 Sport Psychology. (3-0) Cr 3. *Prereq. 360, 3 courses in psychology* Aspects of psychology which form a basis for understanding and explaining behavior in a sport context Variables underlying individual as well as group performance will be analyzed A critical analysis of current research literature

523 Sex Roles and Sport. (W S 523) (2-0) Cr 2 *Prereq 360, 3 courses in sociology and/or psychology* Analysis of the influence of sport on male and female sex role development Survey of literature related to sport and sex role socialization stereotyping, and conflict Discussion of future issues and alternative roles

540 Administration of Physical Education and Sport. (3-0) Cr 3 *Prereq. 475 or 402* Theory and practice of administration in physical education and sport, development of concepts related to the process of administration, types of administrative behavior, tasks and responsibilities of the administrator, evaluation of effectiveness of administration

550. Advanced Physiology of Exercise I. (2-3) Cr 3 *Prereq 455* Concepts and methodology in assessing neurological, muscular, cardiovascular, and respiratory adjustments to exercise.

551 Advanced Physiology of Exercise II. (2-3) Cr 3 *Prereq 455* Analysis of factors affecting work capacity and performance Human energy metabolism concepts and measurement

560 Perceptual Motor Learning. (2-3) Cr 3 *Prereq 370, Psych 333 or equivalent* Emphasis on theories of perceptual motor learning characteristics of the learner and the learning environment with implications for the design of learning settings and further research

561 Movement, Motor Ability, and Motor Performance of Children (2-0) Cr 2 *Prereq 284, Psych 230* The physical development and characteristic reactions of children in relation to motor performance Identification of special psychomotor needs of various age groups of children All literature and theories applied to the physical education environment

570 (DL 395) Adapted Physical Education. (2-3) Cr 3. *Prereq 375* Graduate study in conjunction with P E 395 Additional readings, term project, and special examination required. May not be taken by students who have previously earned credit in P E 390 or 392 or 395

590 Special Topics. Cr 1 to 3
A Physical education
B Leisure studies

591 Supervised Field Experience. (0-2 to 6) Cr 1 to 4 *Prereq 10 graduate credits in physical education and/or related areas* Supervised on-the-job field experience in special areas.
A Physical education
B Leisure studies

593. Workshops. Cr 1 to 3
A Physical education
B Leisure studies

Courses for Graduate Students, major or minor.

615. Seminar. (1-3-0) Cr 1 to 3
A Physical education
B Leisure studies

699. Research. Cr arr *Prereq. 10 credits in education*

Physics

Clayton A Swenson, Chair of Department

Professors: Barnes, Bowen, Carlson, Clem, Danielson, Finnemore, Firestone, Fuchs, Grossman, Hammer, Hodges, Kernan, Kliewer, Lamb, Lassila, Liu, Lynch, Pursey, Ruedenberg, Stanford, Stassis, Swenson, Weber, Williams, Wolf, Young, Zaffarano

Emeritus Professors: Carr, Earls, Jensen, Kirkham, Legvold, Spedding

Associate Professors: Anderson, Beavers, Cook, Crawley, Harmon, Hill, Leacock, Parker, Peterson, Ross, Vary, Willson, Wohn

Assistant Professors: Dixon, Klemm, Lewis, Nolan, Rosenberg, Shelton, Staudenmann

Undergraduate Study

For the undergraduate curriculum in sciences and humanities, major in physics, leading to the degree Bachelor of Science, see *Sciences and Humanities, Curriculum*

Physics and astronomy are basic natural sciences that attempt to describe, and provide an understanding of, our universe The study of physics is an enlightening starting point for understanding many different disciplines Students may choose physics for their major subject not only as preparation toward a career as a professional physicist or high school teacher, but also as a challenging approach to personal development or as preparation for such diverse areas as business administration, law, medicine, and others Although many opportunities exist for men and women who terminate their studies with a bachelor's degree, students who meet the necessary scholastic standards often continue their studies in a graduate college where opportunities exist to explore and contribute to the most recent developments in the field

The department normally expects each student majoring in physics to complete at least the following courses Phys 221, 221L, 222, 222L, 321, 321L, 322, 322L, 304, 361, 364, 398, and one of 311, 311T, or Astro 344L This is not a rigid requirement, however, and changes in that basic list will be approved by the departmental curriculum committee on recommendation of the student's adviser when these will better serve the individual's needs In particular, students planning a physics major and also seeking certification for high school teaching may, with the approval of their adviser, follow a significantly different program designed to meet their special needs, these students should consult the department for further information In any case each student must earn at least 7 credits in laboratory work, either in the courses listed above or in approved substitutions, and must earn at least 20 credits in physics and astronomy in courses numbered 304 or higher

Students wishing an emphasis in astronomy or astrophysics should add Astro 344-345 to the above list of courses and should take Astro 344L; well qualified students may also include some 500-level astronomy courses Those planning graduate work in physics, astonomy, or astrophysics should add Phys 365, 396, 480, and 481 to the basic course list; they are encouraged also to add one or more of Phys 511, 524, and 537, according to their areas of special interest. Students planning graduate work are also strongly encouraged to study at least one foreign language. Further information concerning programs of study, including sample degree programs, is available from the department.

Graduate Study

The department offers work for the degree Master of Science and for the degree Doctor of Philosophy with majors in physics, astrophysics, high energy physics, nuclear physics, and solid-state physics, and minor work to students majoring in other departments

Facilities of the department and in the Ames Laboratory are available for both theoretical and expenmental research

Students with bachelor's degrees in physics or astronomy from other institutions ordinarily will qualify for graduate study here provided they have satisfactorily completed course work similar to that suggested for undergraduate physics majors at this University. In some cases, additional instruction at the intermediate level may be required

The degree Master of Science in physics is offered both with and without thesis. In either case, the basic requirements are the same. at least 30 credits of acceptable graduate work must be completed, not less than 21 of which must be in physics or astronomy and not less than 6 either from outside the department or in areas different from the student's major area. At least 15 of the credits in physics must be in courses at the 500 or 600 level exclusive of 595 and 699 Students choosing a degree with thesis may apply up to 8 credits of 699 but no credits of 595 toward the minimum 30 credits. Students choosing a degree without thesis should apply 1 credit per semester of 595, up to 2 credits, but may not apply any credits of 699 toward the minimum 30 credits

Each candidate for the Doctor of Philosophy degree is required to teach one year of elementary physics In addition to course work in the major area a candidate must take 12 minor credit hours outside this area, not less than 6 of which must be from other departments

The Physics Department cooperates in the interdepartmental minor in Technology and Social Change (See *Technology and Social Change)*

Open for graduate minor credit only. Phys 304, 311, 361, 364, 365, 396, 447, 480, 481, and Astro 344, 344L, 345

Astronomy and Astrophysics (Astro)

Courses Primarily for Undergraduate Students

120. The Sky and the Solar System. (3-0) Cr 3 F S Designed for the nonscientist. The sky: constellations; motions of the sun, moon, and planets; seasons and the calendar; eclipses The solar system: origin and evolution; characteristics of the sun, planets, satellites, comets, meteorites, results of recent space probes. Extensive use of the planetarium is included.

150. Stars, Galaxies, and Cosmology. (3-0) Cr 3. F S.SS Designed for the nonscientist. Observational aspects of stellar astronomy: motions, distances, sizes, spectra, types of stars; variability; binary systems. Stellar evolution: the birth, life, and death of stars, including supernovae, neutron stars, and black holes. The Milky Way Galaxy: clouds of matter in space, the structure and evolution of our galaxy. Other galaxies, clusters of galaxies, quasars. Theories of the origin of the universe

290. Independent Study. Cr. 1 to 4 each time taken. *Prereq: Permission of instructor.*

344, 345. Introductory Astrophysics. (3-0) Cr. 3 each. Yr *Prereq. 344: Phys 222; 345: 344* 344: The solar system.

Astronomical techniques and coordinate systems Observational aspects of stellar astronomy· spectral classification, variable stars, binary stars, star clusters 345 Stellar astrophysics· structure and evolution of stars, origin and interpretation of stellar spectra. Interstellar matter, nebulae, galaxies, cosmology

344L. Astronomy Laboratory. (0-6) Cr 3. F *Prereq· Credit or classification in 344* Observational techniques and experiments in optical astronomy

450, 450L. Undergraduate Research. Cr 1 to 6 each time taken F S SS *Prereq· 450: Permission of instructor; 450L. 344L and permission of instructor* 450 Research under supervision of astronomy faculty 450L Laboratory or observational project under supervision of astronomy faculty

490. Independent Study. Cr 1 to 4 each time taken *Prereq· Permission of instructor*
H Honors

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

510. Observational Astrophysics. (1-4) Cr 3 Alt F, offered 1981 *Prereq 345* Techniques of astronomical data acquisition, analysis, and interpretation as applicable in studies in photometry, spectroscopy, binary stars, parallax, and proper motion Observing projects for gaining proficiency in the use of astronomical telescopes, instruments, and coordinate systems

518. Radio Astronomy and Astrophysics (E E 518) (3-0) Cr 3 Alt S, offered 1982 *Prereq 365 or E E 313* Radio astronomy fundamentals, wave polarization and measurement, radio telescope receivers and antennas, wave propagation in plasmas, synchrotron emission, continuum and line spectra, physical conditions in radio sources

550. Galactic and Extragalactic Astronomy. (3-0) Cr 3 S *Prereq 345, Phys 322* The interstellar medium, galactic structure, dynamics of external galaxies, evolution and classification of galaxies, extragalactic radio sources, quasars, cosmological models

580 Stellar Evolution and Nucleosynthesis. (3-0) Cr 3 Alt S, offered 1983 *Prereq. 345, Phys 322* Solution of the equations of stellar structure, analytic approximations and theorems relating to equilibrium stellar models, survey of the results of numerical calculations of stellar evolution, nucleosynthesis in massive stars, final phases of stellar evolution, evolution of close binaries

585. Radiative Transfer, Stellar Atmospheres, and Spectroscopy. (3-0) Cr 3 Alt F, offered 1982 *Prereq 345, Phys 322* Basic methods of radiative transfer with applications in stellar interiors, stellar and planetary atmospheres Theory and interpretation of astronomical spectra line profiles, LTE and non-LTE line formation, interpretation of spectra observed at high resolution and low resolution, abundances, model atmospheres, and curves of growth

590 Special topics. Cr var

595. Tutorial Astrophysics. Cr var *Prereq Permission of instructor* Individually directed study of research-level problems for students electing the nonthesis M S option in astronomy

Courses for Graduate Students, major or minor

650 Advanced Seminar. (1-0) Cr 1 each time taken F S Topics of current interest in astronomy and astrophysics

660. Advanced Topics in Astronomy and Astrophysics Cr 1 to 3 each time taken F S. Topics in stellar interiors and evolution, stellar atmospheres, interstellar matter, cosmology, solar physics, astronomical sources, and recent developments

699. Research.

Physics (Phys)

Courses Primarily for Undergraduate Students

100. Introductory Seminar. (1-1) Cr ½. F Survey of current research in physics and astronomy Discussion of careers based on a major in physics Offered on a satisfactory-fail basis only

101. Physics for the Nonscientist. (3-0) Cr 3 F,S Survey of the principal areas of physics, both classical and modern, emphasizing the scope, methods, and goals of physics, and its relation to other fields of human activity

106. The Physics of Common Experience. (4-2) Cr 4 F S SS Elementary topics from mechanics, heat, electricity, sound, and light, emphasizing the use of basic principles to understand everyday experience Includes practical problem exercises and a coordinated laboratory

111, 112. General Physics. (4-2) Cr 4 each 111 F S SS, 112 F S *Prereq 111 1½ years of high school algebra, 1 year of geometry, 1 semester of trigonometry, 112 111* General background in physical concepts, principles, and methods for those who do not plan advanced study in physics or engineering Applications related to the biological sciences 111 Mechanics, fluids, heat and thermodynamics, vibrations, waves, sound, ray optics 112 Electricity and magnetism, wave optics, topics in modern physics

198. Physics of Music. (2-2) Cr 3 F Introductory-level course for nonphysics majors Properties of sound, human perception of sound, room acoustics, musical scales, production and analysis of musical sounds by voice, string, woodwind, brass, percussion, and electronic instruments

199. Physics of Sound Reproduction. (2-0) Cr 2 S Introductory-level course for nonphysics majors The nature of sound, microphones, amplifiers, disc and tape signal storage and playback systems, speaker transducers, AM and FM transmission and reception

221. Introduction to Classical Physics I. (5-0) Cr 5 F S SS *Prereq Math 165 or 175.* For engineering and science majors Elementary mechanics, including kinematics and dynamics of particles, work and energy, linear and angular momentum, conservation laws, rotational motion, oscillations, gravitation Electric forces and fields Current electricity, DC circuits

221L Introductory Laboratory in Classical Physics I. (0-3) Cr 1 S *Prereq Credit or classification in 221* Experimental studies relevant to motion, energy, oscillations, electric charge, and DC circuits Computer simulation of physical systems For physics majors and others seeking strong emphasis in physics

222. Introduction to Classical Physics II (5-0) Cr 5 F S *Prereq 221, Math 166 or 176* Magnetic forces and fields, time-dependent electromagnetic fields, waves and sound, electromagnetic waves, ray optics and image formation, wave optics, heat, thermodynamics, kinetic theory of gases

222L. Introductory Laboratory in Classical Physics II (0-3) Cr 1 F *Prereq Credit or classification in 222* Experimental studies relevant to electrical circuits and circuit oscillations, magnetism, electromagnetism, waves, light, and thermodynamics For physics majors and others seeking strong emphasis in physics

224 Laboratory Survey of Classical Physics. (0-2) Cr 1 F S *Prereq Credit or classification in 222* Experimental studies relevant to classical physics Force, motion, energy, waves, electricity, magnetism, and optics Measurement techniques and the experimental basis of physical theories are emphasized

271. Physics, History, and Society I. (Hist 271) (3-0) Cr 3 Alt F, offered 1981 Open to all undergraduates Examination of the assumptions upon which the sciences and humanities rest, and of their impact upon society The physical concepts, theories, and experiments of Tycho, Kepler, Galileo, and Newton and the philosophy and history of science of Koyre, Kuhn, and others are studied with respect to assumptions, techniques, goals, and results in order to illuminate the nature of the sciences and the arts

272. Physics, History, and Society II (Hist 272) (3-0) Cr 3 Alt F, offered 1982 Open to all undergraduates The lives and physical thinking of Einstein, Oppenheimer, and other physicists, emphasis on the theoretical, experimental, and technological aspects of special relativity Historical analysis of the scientific background, development, and use of nuclear weapons, interaction of scientific and technological concepts with social structures Scientific and historical methods and results are compared

290. Independent Study. Cr 1 to 4 each time taken *Prereq. Permission of instructor*

302. The Challenge of Contemporary Physics. (3-0) Cr 3 S. A largely nonmathematical but intellectually challenging exploration of physics which assumes no previous work in the field Selected material from classical and modern physics establishes the conceptual framework for the study of e major area of contemporary physics, culminating in the discussion of topics at the frontier of present knowledge. Research topics vary from year to year and may include new particles, quarks, superconductivity, lasers, nuclear fusion, liquid crystals, solid state devices, gravitational waves

304. Thermal Physics. (3-0) Cr 3 F *Prereq 222, Math 266 or 371* Concepts of temperature, entropy, and other characteristic thermodynamic functions, with application to macroscopic properties of matter The laws of thermodynamics, heat engines, efficiencies Kinetic theory and the Maxwell velocity distribution Introduction to statistical mechanics, including quantum statistics Application to black body radiation, crystalline vibrations, magnetic ions in solids, electronic heat capacity of metals

311, 311T. Intermediate Laboratory. (0-6) Cr 3 each time taken 311 S, 311T S *Prereq 311 322 or 324, 311T 321 or 324* Experiments in classical and modern physics performed independently by each student Section 311T is for students preparing for a career in high school teaching

321. Introduction to Modern Physics I. (3-0) Cr 3 S *Prereq 222, credit or classification in Math 266 or 371* Special relativity Quantum nature of matter photons, Bohr model of hydrogen, de Broglie wavelength of matter and wave packet description of particles Schroedinger wave equation in one dimension energy quantization, detailed solutions for potential steps, barriers and wells Schroedinger equation for one-electron atoms

321L. Introductory Laboratory in Modern Physics (0-2) Cr 1 S *Prereq Credit or classification in 321* Experiments related to the foundations of modern physics The dual wave and particle character of electrons and photons, radioactive decay, and statistics

322. Introduction to Modern Physics II (3-0) Cr 3 F *Prereq· 321* Electron spin, X-ray and optical excitations of multi-electron atoms, quantum statistics, lasers, physics of molecules Properties of solids, including electron band structure, semiconducting materials and devices, superconductivity and magnetism Nuclear physics, including nuclear sizes and masses, stability decay modes, reactions, fission and fusion Elementary particles, including strangeness, charm, and quarks

322L. Introductory Laboratory in Modern Physics II (0-1) Cr 1 F *Prereq Credit or classification in 322* Experiments related to the foundations of modern physics Atomic spectroscopy, Michelson interferometer, microwaves, elementary particles, and instrumentation

324 Elementary Modern Physics. (3-0) Cr 3 F *Prereq 222, Math 266 or 371* For engineering and science majors Special theory of relativity, wave-particle nature of light and matter, quantum theory of atoms, nuclear physics

325. Elementary Solid State Physics. (3-0) Cr 3 S *Prereq 324* Molecular and crystal binding, quantum theory of metals and semiconductors, physics of semiconductor junction diodes and transistors

331. Relativity. (2-0) Cr 2 S *Prereq 222, credit or classification in Math 266 or 371* Introduction to special and general relativity The postulates of special relativity, length contraction, time dilation, simultaneity Lorentz transformation, the 4-vector system of space-time, relativistic mechanics The physical foundations of general relativity, inertial and gravitational mass, the equivalence principle, experimental tests of the general theory

350 Energy and the Environment. (3-0) Cr 3 S *Prereq 112 or 222* Topics of current interest in energy use, development, and conservation Discussion of research, future energy alternatives, effects on environment

351. Energy Analysis of Residential Structures. (3-0) Cr 3 S *Prereq 222* The architectural design and technical analysis of residential structures that emphasize energy conservation and solar energy utilization Field trips This course meets concurrently with Arch 468, and students from the two courses work as teams on specific design projects

361 Classical Mechanics. (4-0) Cr 4 F *Prereq 221, Math 266 or 371* Newtonian mechanics, including linear forced oscillations, central forces and orbital motion, moving reference frames, Lagrange's equations, rotation of rigid bodies, theory of small vibrations

364. Electricity and Magnetism I. (3-0) Cr 3 S *Prereq 222, Math 385* Electrostatics, electromagnetism and relativity, magnetostatics, potential theory

365. Electricity and Magnetism II. (2-0) Cr 2 F *Prereq 364* Time variation of electromagnetic fields, radiation, interaction with matter; interference and diffraction, waveguides and cavities

396. Optics. (3-0) Cr 3 S *Prereq 321 or 324* Physical optics. interference, diffraction, scattering, polarization, coherence, topics in quantum optics

398. Seminar. (1-0) Cr ½ S Required of all junior physics majors Career opportunities for physics majors discussed by faculty and visitors. Offered on a satisfactory-fail basis only

399 Seminar on Secondary School Physics. (2-0) Cr 1 F S *Prereq Permission of instructor* Review of materials and curricula for secondary school physics presented and discussed by members of the class. Required for approval to teach physics in secondary schools

447 Modern Physics. (4-0) Cr 4 F *Prereq. 222, Math 266 or 371* Primarily for graduate students in other fields who desire a fast-paced presentation A concise treatment of some important topics from classical mechanics and electromagnetism, Schroedinger formulation of quantum mechanics and its application to the hydrogen atom, the helium atom, and electrons in a periodic lattice, the semiclassical theory of emission and absorption of radiation

450, 450L. Undergraduate Research. Cr 1 to 6 each time taken F S SS *Prereq. 450 Permission of instructor, 450L. 311, permission of instructor* 450 Experimental or theoretical research under supervision of physics faculty 450L Laboratory project under supervision of physics faculty

480 Quantum Mechanics. (3-0) Cr 3 F *Prereq 322, Math 385* A systematic development of quantum mechanics, including differential and operator solutions of the Schroedinger equation, matrix formulation of eigenvalue problems, angular momentum, and perturbation theory

481 Atomic and Molecular Physics. (2-0) Cr 2 S *Prereq 480* Interaction of electrons with the electromagnetic field, Zeeman effect, Stark effect, hyperfine interaction, helium atom, many-electron atoms, Hartree equation, hydrogen molecule, molecular specific heats, molecular bonding, molecular spectra, radiation of atoms, line width, induced absorption and emission

489 Tutorial Seminar. (1-0) Cr 1 each time taken F S *Prereq Permission of instructor* For junior and senior physics majors Topics of interest in physics discussed in small groups Offered on a satisfactory-fail basis only

490 Independent Study. Cr 1 to 4 each time taken *Prereq Permission of instructor*
H Honors

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

500 Introductory Research Seminar. (1-1) Cr 1 F Discussion by research staff of their research areas, expected thesis research work, and opportunities in the field For graduate physics majors only

511 Solid State Physics. (3-0) Cr 3 S *Prereq. 304, 322* Free electron model, crystal symmetry; band theory of solids, transport properties, Fermi surface, phonons, semiconductors, magnetism, superconductivity

524. Introductory Nuclear Physics. (3-0) Cr 3 F *Prereq 447 or credit or classification in 480.* Basic properties of nuclei and radioactive decay Nuclear detectors and accelerators Phenomenology of nuclear forces and nuclear models.

525. Nuclear Physics. (3-0) Cr 3 Alt S , offered 1982 *Prereq 524* Shell and collective aspects of nuclear structure Nuclear reactions and scattering processes

528. Atmospheric Physics. (3-0) Cr 3. Alt. S , offered 1983 *Prereq 322, 304, 361, and 364.* Physics of fluids as applied to the atmosphere· equations of motion, conservation laws, atmospheric waves, small to planetary scale; observational techniques, lower and upper atmospheric structure and processes.

531 Statistical Mechanics. (3-0) Cr 3 F *Prereq· 304, Math 465, credit or classification in Math 426 or 365* Thermodynamic properties of systems of many particles obeying Boltzmann, Fermi-Dirac, and Bose-Einstein statistics, microcanonical, canonical, and grand canonical ensembles and their application to physical problems, density matrices, introduction to phase transitions, kinetic theory; fluctuations and noise

537 High Energy Physics. (3-0) Cr. 3. S. *Prereq. 480* Experimental methods; conservation laws and invariance principles, weak, electromagnetic and strong interactions, quark model, symmetry schemes, and dynamical models.

541 General Relativity. (3-0) Cr 3 Alt S., offered 1982 *Prereq: 361 or Math 465.* Tensor analysis and differential geometry developed and used to formulate Einstein field equations Schwarzschild and Kerr solutions Other advanced topics such as alternate gravitational theories, attempts at unified field theories, cosmology

564. Advanced Classical Mechanics. (3-0) Cr 3 F *Prereq 361, Math 426, 465* Variational principles, Lagrange's equations, Hamilton's canonical equations, canonical transformation, Hamilton-Jacobi theory, infinitesimal transformations, classical field theory

571, 572. Advanced Electricity and Magnetism. (3-0) Cr 3 each 571 S , 572 F *Prereq 571 365, Math 426, 572 571* 571 Electrostatics, magnetostatics, boundary value problems, Maxwell's equations, electromagnetic fields and wave phenomena in macroscopic media, simple radiation systems, wave guides 572 Relativistic physics special theory of relativity, relativistic particle and electromagnetic field dynamics, radiation by moving charges, collisions between charged particles, bremsstrahlung, radiation

590. Special Topics. Cr var *Prereq Permission of instructor* Topics of current interest in high energy physics, nuclear physics, solid state physics, and atmospheric physics Topics in other areas offered periodically, depending upon current staff interests

591, 592 Quantum Physics. (3-0) Cr 3 each Yr *Prereq 591 480, 592 591* Schroedinger theory, representations, approximation methods, time-dependent problems, elementary scattering theory

595. Tutorial Physics. Cr var *Prereq Permission of instructor* Individually directed study of research-level problems for students electing the nonthesis M S degree option

Courses for Graduate Students, major or minor

611, 612. Quantum Theory of Solids. (3-0) Cr 3 each Yr *Prereq 611 511, 592, 612 611* 611 Electronic band structure, phonons, X-ray, neutron, and electron scattering, dielectric response, Boltzmann equation 612 Optical properties, magnetism, superconductivity

624 Theory of Nuclear Reactions (3-0) Cr 3 Alt F , offered 1982 *Prereq 592 and 524* Theories of nuclear reactions, including compound nuclei, direct reactions, and multiple scattering theory

625 Theory of Nuclear Structure (3-0) Cr 3 Alt S , offered 1983 *Prereq 592 and 525* Current theories of nuclear structure, including microscopic and collective aspects

637, 638. Elementary Particle Physics. (3-0) Cr 3 each Alt Yr , offered 1981-82 *Prereq 637 537, 592, 638 637* Properties of elementary particles and reactions, SU(3) and quark model, relativistic quantum mechanics of particles with any spin, S-matrix theory, quantum electrodynamics and quantum chromodynamics, Regge theory and current algebra.

650. Advanced Seminar. (1-0) Cr 1 each time taken F S Topics of current interest
A Nuclear Physics
B Solid State Physics
C High Energy Physics

660. Advanced Topics in Physics. Cr 1 to 3 each time taken F S Courses on advanced topics and recent developments
A. Nuclear Physics
B Solid State Physics
C High Energy Physics

674. Applications of Group Theory to Physics. Solid State Physics. (3-0) Cr 3 Alt F , offered 1981 *Prereq 592* Theory of groups and group representations, point, space, and rotation groups, applications to molecular and crystal structures, crystal field and spin-orbit interactions, energy bands and phonon dispersion relations

675. Applications of Group Theory to Physics: Nuclear and High Energy Physics. (3-0) Cr 3 Alt S , offered 1982 *Prereq 592.* Theory of Lie groups, Lie algebras, and their representations, detailed expositions of the three-dimensional rotation group, Lorentz group, Poincaré group, and SU(3), survey of other Lie groups of physical importance, applications to nuclear shell structure, angular correlation theory, helicity states, relativistic partial wave analysis, elementary particle properties

681, 682. Quantum Mechanics. (3-0) Cr 3 each Alt. Yr , offered 1982-83 *Prereq. 681 592, 682 681* Angular momentum theory, second quantization, many-particle theory, photons and light scattering, relativistic wave equations with emphasis on Dirac's equation, introduction to quantum electrodynamics

699. Research

Plant Pathology, Seed and Weed Sciences

Abraham H Epstein, Chair of Department

Professors: Browning, Burris, Clark, Dunleavy, Epstein, Hodges, Isely, McNabb, Norton, Nyvall Simons, Staniforth, Stewart, Tachibana, Tiffany

Associate Professors: Fawcett, Foley, Hill, Martinson, McGee, Vakili

Assistant Professors: Braun, Misra, Mullen, Nelson, Sweets

Undergraduate Study

For undergraduate major in plant pathoogy leading to the degree Bachelor of Science, see *Agriculture, Curricula* For a second major in pest management or seed science, see *Agriculture, Curricula.*

The undergraduate programs in plant pathology and seed science are adapted to students of varied interests in agricultural biology Undergraduate minor programs for plant pathology majors include supporting area in agriculture such as agronomy, horticulture, and forestry, and the basic biological and physical sciences, depending on the goals and interests of the individual student The basic curriculum framework is a guide for students and their advisers in planning programs fitting individual needs Such programs prepare graduates for a wide range of agriculture- and science-related occupations including teaching, research, development, and sales programs of agricultural industries, and federal and state departments The secondary major in pest management strongly supports the plant pathology primary major for those students interested in preparing for general pest management positions with industry and governmental agencies. Both majors offer excellent preparation for graduate study in plant pathology, or in related disciplies such as agronomy, biology, botany, horticulture, forestry, plant breeding, plant physiology, pest management, and water resources

The department alone and in cooperation with the pest management program has cooperative work-experience internships with industry and governmental agencies for interested and qualified students Practical experience through part-time employment during the student's formal education program is strongly recommended. Such experience is available in the Seed Science Center and the Plant Health Clinic within the department and with private industry and public agencies

Graduate Study

The department offers studies for the degrees Master of Science and Doctor of Philosophy with a major in plant pathology, and minor work for students majoring in other departments. A Master of Science nonthesis option is available. A student majoring in plant pathology may specialize in seed science or weed science.

Students entering graduate programs in the department need a sound background in the physical, biological, and mathematical sciences as well as adequate preparation in English.

For the degree Doctor of Philosophy, the requirement in foreign language or its alternative is established by the student's advisory committee

Open to graduate students for minor credit only 407, 416, 418, 438.

Courses Primarily for Undergraduate Students

110 Orientation in Plant Pathology. (1-0) Cr R F *Required of students in the plant pathology curriculum* Requirements and career opportunities in the fields of plant pathology and pest management

207. Diseases of Economic Plants. (2-0) Cr 2 S *Prereq: Biol 109 or 110* Braun Diseases of agronomic and horticultural plants, life cycles of causal organisms and methods of disease management employed

216. Weed Identification and Management. (P M 216) (2-3) Cr 3 F S *Prereq Biol 109 or 110* Identification, biology, and distribution of weeds Plant classification pertinent to weedy groups Principles of weed management Field trips

237. Seed Production (Agron 237) See *Agronomy*

238. Seed Technology. (Agron 238) (0-6) Cr 2 F *Prereq Biol 109 or 110, Agron 114* Production, harvesting, processing, quality evaluation, storage, and marketing of seeds Fee for field trips

407 Principles of Plant Pathology (P M 407) (2-3) Cr 3 F S *Prereq 8 credits in botany including 207* Braun Principles underlying the nature, diagnosis, and management of plant diseases

408. Plant Disease Diagnosis. (P M 408) (0-3) Cr 1 F S *Prereq Credit or classification in 407* Braun Laboratory experience in the diagnosis of plant diseases

416. Forest Pest Management. (For 416, Ent 416, P M 416) (2-3 or 3-6) Cr 3 or 5 S *Prereq 8 credits in biological sciences, including Bot 207* McNabb, Hart 3-credit course Nature of forest- and shade-tree pests, agents of deterioration of wood products Separate laboratory for students in resource management or forest products 5-credit course An additional lecture and arranged laboratory using integrated case studies and computer simulations in the evaluation and economic analysis of protection and pest management problems, physical agents of tree damage, weekend field trips Fee for field trips

418 Weed Control with Herbicides. (P M 418) (2-0) Cr 2 S *Prereq 216, Bot 310 or 320* Staniforth Principles and practices of modern weed control with emphasis on herbicide technology, herbicide selectivity, mode of action, crop phytotoxicity and the fate of herbicides in the environment, weed biology and ecology as related to the efficacy of herbicides

438. Seed Biology. (agron 438) (2-3) Cr 3 Alt F, offered 1982 *Prereq Bot 310 or 320* Burns, McGee Physiological aspects of seed development, maturation longevity, and germination, seed pathology, ecological and agricultural implications of seed biology

490. Independent Study. Cr 1 to 3 each time taken *Prereq 7 credits in biological sciences, permission of instructor*
A Plant Pathology
B Seed Science
C Weed Science
H Honors

491. Seed Science Experience. Cr 2 to 4 *Prereq. 238, permission of instructor* Practical experience in the seed industry For majors and advanced students

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

509 Plant Virology. (Micro 509) (2-6) Cr 4 Alt S, offered 1982 *Prereq 407, Bot 404, B B 406, Chem 211* Hill Plant viruses and the diseases they cause Emphasis on epidemiology and control Structure, function, and biochemical-biophysical properties of plant viruses

541. Epidemiology and Control of Plant Diseases. (3-0) Cr 3 F *Prereq 407 or 416, Agron 421 or For 501 or Hort 525.* Browning Environmental and genetic control of disease development, theories of managing resistance genes and cultural practices to maximize natural control processes.

544. Advanced Forest Pest Management. (For 544, Ent 544) (2-3) Cr 3. Alt. F, offered 1982 *Prereq. 416* McNabb, Hart. Systems analysis approach to the management of forest and shade-tree pests, planning of research on such pests Fee for field trips

574. Plant Nematology.)2-2) Cr 3 F *Prereq 407 or 416* Norton Morphology, anatomy, life cycles, and local distribution of commonly encountered plant-parasitic nematodes, symptom expression, control

576. Bacterial Diseases of Plants (2-3) Cr 3 Alt F, offered 1982 *Prereq 407 or 416, Bact 300* Braun Characteristics of prokaryotic plant pathogens and the diseases they cause Laboratory emphasizes techniques used in studying bacterial plant pathogens

590. Special Topics. Cr 1 to 3 each time taken *Prereq 10 credits in biological sciences, permission of instructor*
A. Plant Pathology
B Seed Science
C Weed Science

591. Advanced Plant Pathology. (3-3) Cr 4 Alt S, offered 1982 *Prereq 407 or 416* Martinson Plant disease concepts and processes, representative plant diseases with emphasis on fungus diseases, ecology of fungus pathogens, and literature review

Courses for Graduate Students, major or minor

691. Clinical Plant Pathology (0-6) Cr 2 each time taken Alt SS, offered 1982 *Prereq 541, 591, permission of instructor* Nyvall Diagnosis of plant diseases, isolation and identification of pathogens, clinical experience, plant disease survey, detection and evaluation methods

692. Plant Disease Physiology (2-3) Cr 3 Alt S, offered 1983 *Prereq 407 or 416, Bot 320* Martinson Physiological and morphological aspects of parasitism, host response to pathogens, physiology of resistance mechanisms, and specificity in disease interactions

698. Seminar Cr 1 F S
A Plant Pathology
B Seed Science
C Weed Science

699. Thesis and Dissertation Research Cr var
A Plant Pathology
B Seed Science
C Weed Science

Political Science

Victor A Olorunsola, Chair of Department

Professors: Boles, Dorfman, Hadwiger, Kihl, Olorunsola, Parks, Rasmussen, Talbot, Wiggins

Associate Professors: Hutter, McCormick, Moses, Schmidt, Wessel, Whitmer

Assistant Professors: Daley, Lee, Maney, Shakeshaft, Shelley

Instructor: Coates

Undergraduate Study

For the undergraduate curriculum in sciences and humanties, with major in political science, leading to the degree of Bachelor of Arts, see *Sciences and Humanities, Curriculum*

The study of political science is designed to enable students to become familiar with theories of public values and patterns of political systems — national, regional, and international A political science major should complete a broad, liberal arts program, which would maximize opportunities for study in related social science disciplines, as well as in various areas of the humanities

Each student majoring in political science will work out with an adviser appropriate means for beginning to develop a facility in the use of a research tool As a minimum, each student should have eight semester credits in a research tool, such as a single foreign language or quantitative techniques

Students majoring in political science may substitute a second major in international studies in place of an optional minor in the College of Sciences and Humanities See *International Studies*

A political science minor has also been used by many students with majors in other disciplines The availability of the minor is noted because so many occupations and activities are affected by politics and governmental activity For information on a minor in political science, contact the department office

A *prelaw* undergraduate program of study is offered and can be pursued through a major in political science A more complete statement is available in the department office See also *Preprofessional Study*

A detailed statement of departmental requirements may be obtained from the departmental office

Graduate Study

The department offers work for the degree Master of Arts with major in political science and minor work to students majoring in other departments

The program is designed to enable its graduates to engage in governmental research, enter public service or private industry, pursue further graduate study, or teach Both thesis and nonthesis options are available Within either option, a specialization in public administration is possible This department also has a joint Juris Doctor/Master of Arts Program with the Law School of Drake University In addition, graduate students may wish to work for certification for high school or junior college teaching

The department also offers a Master of Public Administration This is a professional degree in public administration It is designed to provide interested students with the training necessary to operate within a public bureaucracy and organization. The M P A. degree requires 39 semester credit hours

Brochures setting forth the detailed requirements for the degrees within each option, for the M.A./J.D degree, and the M.P A. degree may be obtained from the political science office

A usual prerequisite for major graduate work in the department is the completion of at least 15 semester credits in political science The Graduate Record Examination (for both aptitude and advanced examinations) is strongly recommended

Each student entering the Master of Arts program in political science is expected to have completed one year of a foreign language (equivalent to eight semester credits) and a course in basic statistics (equivalent to Stat 101) If this has not been done, the student may remedy the deficiency by passing equivalent courses, for which no graduate credit will be received

In addition, each student must complete one of the following requirements:

(1) Language — Two years of undergraduate instruction (including the one year of foreign language provided above) in a single language, with grades averaging 2 7 (on a 4.0 scale), or, a passing grade in the Educational Testing Service examination

(2) Statistics — Successful completion of Stat 401 Stat 402 is recommended, but not required

These requirements are only the basic minima The student's program of study committee will decide if additional work, in either language or statistics, is necessary.

The department also offers a Master of Arts program, with no language requirement and a choice of a thesis or an internship requirement, to those students who wish to prepare for, or are employed in, government service.

The department cooperates in the interdepartmental programs of Industrial Relations, Transportation Planning, and Technology and Social Change. (See Index)

Courses open to graduate students for minor credit only 410, 411, 420, 421, 422, 430, 431, 433, 443, 444, 447, 448, 451, 452, 453, 457, 464, 471, 475, 476, 478, 480, 481, 482, 484

Courses Primarily for Undergraduate Students

215 American Government: Institutions and Policies. (3-0) Cr 3 F S Fundamentals of American democracy, constitutionalism, nature of federalism; rights and duties of citizens, institutions and processes of the executive, legislative, and judicial branches of government, role of public opinion, interest groups, and political parties Policies and problems of national government

230 Introduction to Political Philosophy. (4-0) Cr 4 F *Prereq Sophomore classification* Talbot General review of the theories of the major Western political philosophers Application of these theories to contemporary philosophical issues. freedom, authority, power, legitimacy, order, equality, external security, public welfare

241 Introduction to Comparative Government and Politics. (3-0) Cr 3 F S Basic concepts and major theories, application to selected political systems, including non-western and communist political systems

251 Introduction to International Politics. (3-0) Cr 3 F S Dynamics of interstate relations pertaining to nationalism, the nation state, peace and war; foreign policy making, the national interest; military capability and strategy, case studies of transnational issues, such as population, food, energy, and terrorism

301 Introduction to Empirical Political Research. (3-0) Cr 3 *Prereq 3 credits in political science.* Techniques of empirical political research and analysis: surveys, legislative, judicial, and election data, introduction to statistics and computer techniques

305. Political Behavior. (3-0) Cr 3 *Prereq 3 credits in political science* Hutter Empirical theories and descriptions of political behavior, including decision-making, voting, opinion and attitudes of both the public and political elites

306. Political Decision-Making and Conflict Resolution. (3-0) Cr 3 Alt F *Prereq: 3 credits in political science* Study of domestic and international political conflict in both quasi-historical and hypothetical scenarios by means of simulation and gaming Utility of simulation as a heuristic device, factors influencing the decision-making process through which conflict is resolved

310 State and Local Government. (3-0) Cr 3 F S *Prereq 3 credits in political science* Wiggins Role of state and local governments in American political process Federalism as viewed from the states Key linkage mechanisms in state and local politics: political parties, interest groups, and elections Structure and behavior of major governmental branches legislative, executive, and judiciary Structure and functions of local governments in the United States

311 Municipal Government and Politics. (3-0) Cr 3 F S *Prereq 215* Maney Legal position of municipal corporation, forms of organization, administration of municipal services, problem-solving in municipal government; urban and metropolitan political process, implications of federal urban policies.

320 American Judical Process. (3-0) Cr 3 F S *Prereq 215* Shakeshaft. The genesis, structure, processes, and personnel of American courts; basic juridical concepts, restraints on exercise of the judicial power, major eras of American constitutional history; an overview of civil liberties; impact of court decisions on public policy

340. Politics of Developing Areas. (3-0) Cr 3 S Olorunsola. Analysis of indices of underdevelopment as they relate to the political process of developed states Impact of social and technological change on political systems of developing areas Some case studies

341. Politics of Japan. (3-0) Cr 3 Alt F Kihl Political traditions and cultures Contemporary governmental structures and processes Examination of public policy issues in Japan as a post-industrial society

342. Politics of China. (3-0) Cr 3 F Kihl The Chinese Revolution origins, political theory and practice, party and government China as a modernizing nation including the problems of leadership succession and economic transformation

343. Latin American Government and Politics. (3-0) Cr 3 Alt S Schmidt Political institutions, processes, and contemporary issues Selected countries examined intensively to illustrate generalizations Role of parties, military, church, interest groups, and ideology

345. British Politics. (3-0) Cr 3 F Dorfman, Rasmussen Social and cultural context of British politics Parties, elections, and governmental structures Substance and process of public policies in selected problem areas

346. Governments of Western Europe. (3-0) Cr 3 S Dorfman, Rasmussen Comparative study of political institutions of France, Germany, and Italy; emphasis on parties, elections, and governmental structures Substance and process of public policies in selected problem areas

347. Introduction to African Politics. (3-0) Cr 3 Alt S Olorunsola. Traditional political cultures of sub-Saharan Africa, colonial regimes and rise of nationalism, modern political processes and institutions, illustrations from various parts of sub-Saharan Africa

348. Society and Politics of Israel. (3-0) Cr 3 Alt S *Prereq 241 or comparable background in Middle East/Israeli history* Moses Major factors that have shaped and continue to influence the distinctive nature of Israeli society and politics Origins of nation state, Zionist political ideology and Judaism, political processes and institutions, role of social classes and minorities, impact of the Arab-Israeli conflict on internal Israeli politics

358. United States Foreign Policy. (3-0) Cr 3 F S *Prereq 215 or 251, or Hist 467 or 468* McCormick U S foreign policy since World War II with emphasis on changing American values in foreign policy, the role of the President, Congress, and the bureaucracy in policymaking, and a survey of current foreign policy issues and problems

360. Congress and the State Legislatures. (3-0) Cr 3 F *Prereq. 215* Wiggins Theory of representation in democratic government Organization, procedures, voting patterns, and leadership roles of United States Congress and state legislatures

361. The President and the State Governors. (3-0) Cr 3 S *Prereq: 215* Hadwiger Creation and historical development of the office of chief executive, character and behavior of past chief executives, selection and control, powers, roles, functions, executive staff, relations with Congress, press, public opinion

371. Introduction to Public Administration. (3-0) Cr 3 F *Prereq: 215* The development of public administration in federal, state, and local government Analysis of the organization and operations of public agencies in terms of efficiency and effectiveness in developing and implementing public policy

385. Women in Politics (W S 385) (3-0) Cr 3 S Development of feminism in western democracies, interest groups and leadership in the struggle for political power; countervailing socioeconomic forces that have inhibited women's participation in politics and government, contemporary issues and strategies for change through the political process, emphasis on the United States

405. Political Socialization, Opinion, and Voting Behavior. (3-0) Cr 3 S Acquisition of political attitudes by pre-adults and adults and their expression in opinions and actions, especially voting, voting patterns, implications for campaigns and elections.

410. Iowa Government and Politics. (3-0) Cr 3 F *Prereq: 215* Wiggins Analysis of Iowa government and politics, focusing upon major institutions of government: political parties, interest groups, legislature, supreme court and chief executive Role of municipalities and counties as local units of Iowa government

411. Public Policy and Local Government. (3-0) Cr 3 Alt. S *Prereq 310.* Boles Analysis of structure, administration, and legal basis of the county, township, and special districts, such as school and drainage districts Evaluation of local governmental functions, such as education, welfare, highways, including problems of taxation and finance. Effects of population shifts on future of local governments.

420. Constitutional Law. (3-0) Cr 3. F. *Prereq: 215, junior classification* Boles. Development of the United States Constitution through judicial action, influence of public law and judicial interpretations upon American government and society.

421. Civil Liberties. (3-0) Cr 3 S *Prereq: 215; junior classification* Boles American constitutional and statutory guarantees of civil rights. First Amendment rights of conscience and freedom of expression as well as rights of defendants Application of equal protection of laws to minority groups. Various reform proposals.

422. International Law. (3-0) Cr 3 S *Prereq: 215 or 251, junior classification* Dorfman Develoment of the principles of international law of peace and war, analysis of theories concerning its nature and fundamental conceptions, its relation to national law; problems of international legislation and codification

425. Public Law and Public Policy. (3-0) Cr 3. Alt S. *Prereq 320 or 420* Boles Role of federal judiciary in policy making in the United States. Jurisdictional limitations and judicial attitudes and personality in the decision-making process. Statistical analyses of judicial behavior

430. Development of Political Thought: Classical Thought through Early Contract Theory. (3-0) Cr. 3 F *Prereq. 6 credits in political science, philosophy, or European history* Shakeshaft. Major concepts in original texts of classical, medieval, and early modern authors friendship, community, man's basic nature; natural law, force, society outside the political order Emergence of the modern state and sovereignty in the transition to secular authority Relevant historical considerations, contemporary applications. Plato through Hobbes.

431. Development of Political Thought: Modern and Contemporary Political Thought. (3-0) Cr. 3. S. *Prereq: 6 credits in political science, philosophy, or European history* Shakeshaft Original texts and relevant historical considerations Human nature and its influence on contract theory; private rights; differing connotations of liberty, sovereignty; constitutionalism; dialectical materialism, bureaucracy; law; democrectic theory Locke through Marx, Mill, and contemporary authors.

433. American Political Thought. (3-0) Cr. 3. S. *Prereq: 6 credits in political science or in American history* Talbot Review of major political concepts and theorists in American political history Analysis of current concepts in U S political thought, and their possible impacts on our political institutions.

443. The U.S. and Latin America. (3-0) Cr 3 Alt S *Prereq 241 or 251 or 343* Schmidt Analysis of the political consequences of Latin American dependency and growth of nationalism. Monroe Doctrine, aid, revolution, nationalization, multinational corporations

444. Government and Politics of the Soviet Union. (3-0) Cr 3 F *Prereq 241* Moses Analysis of Soviet political system and society Organization and functioning of the Communist Party and its role in development of the Soviet Union Problems of continuity and change in structure, processes, and policies of the Soviet political system.

447. Development in African Politics. (3-0) Cr. 3 Alt S *Prereq 241 or 340 or 347* Olorunsola. Examination of various developmental problems in African politics and policies; e g , economic growth, equity, rural-urban relationships, political stability, integration, and institution building, the degree to which development is at the core of African aspirations

448. The Military and Politics. (3-0) Cr 3. Alt. F *Prereq: 241* Olorunsola. Type and nature of civil military relations, why and how the military intervenes in politics, theories of the military and development. Case studies of developmental performance of the military, possibilities of military disengagement.

451. Asia in World Politics. (3-0) Cr. 3. Alt. S. *Prereq: 241 or 251.* Kihl. International politics of Asia; emphasis on shifting power balance, role of major powers, security dilemma, foreign policies of small nations, prospect for regional integration.

452. Comparative Foreign Policy. (3-0) Cr 3. F *Prereq. 251.* Kihl, McCormick. Various theoretical approaches to explain foreign policymaking and behavior through the use of case studies of selected nations.

453. International Organizations. (3-0) Cr. 3. S. *Prereq: 251* Kihl Private and public organizations such as the United Nations, other specialized agencies, and

multinational organizations, and their influence on our daily lives

457. Soviet Foreign Policy (3-0) Cr 3 S *Prereq 251* Moses Basic factors determining formulation and execution of Soviet foreign policy Analysis of process and development of foreign policy since 1945, emphasizing the post-Stalin period in Europe, in intrabloc relations, and in the Third World

464. Political Parties and Interest Groups in American Politics. (3-0) Cr 3. S *Prereq 215.* Structure and operations of interest groups and parties, relationships between parties and interest groups and functions they perform in the political system

471. Administrative Politics. (3-0) Cr 3 F *Prereq 215* Wessel The regulatory process, structure and politics of regulatory agencies, political interactions of agencies, legislators, interest groups, and the legal system

475. Techniques of Public Administration. (3-0) Cr 3 S *Prereq 371* Major techniques involved in communications, finance and personnel administration, intergovernmental relations and policy analysis in agencies of the federal, state, and local government

476. Administrative Law (3-0) Cr 3 S *Prereq 215, junior classification* Boles Constitutional problems of delegation of governmental powers, elements of fair administrative procedures, judicial control over administrative determinations

478. Development Administration. (3-0) Cr 3 Alt F *Prereq junior classification* Olorunsola, Wessel Theories and practices of the administration of development Role of bureaucracy in system maintenance, control and change in developing states Case studies of some development projects in developed and developing countries

480. Ethics and Public Policy. (3-0) Cr 3 S *Prereq 6 credits in political science* Talbot Major ethical concepts in U S political philosophy The controversy over public versus private morality in political policy-making Analysis of public decision-making case studies, with particular emphasis on the ethical consideration involved therein Major proposals and legislation related to improving the quality of ethical criteria and decisions in public policy-making

481 World Food and Development Assistance Politics (3-0) Cr 3 F *Prereq 6 credits in political science* Talbot International and U S food policies since the World Food Conference, relative to food aid, nutrition, food security, and commodity agreements Emphasis on development assistance concepts and policies, multilateral and bilateral Analysis of the decision-making process within and between world food and development-assistance institutions, and within the U S Government Proposals for their improvement made by international and national commissions and agencies

482 Environmental and Land Use Politics and Policies (3-0) Cr 3 S *Prereq 6 credits in political science* Talbot Major ideologies relating to conservation and ecology Primary emphasis on the policy-making process in U S national and state governments, with principal application to environmental and land-use policies Major proposals for improvement in policy content and process

484 Farm and Small Town Development Policies (3-0) Cr 3 F *Prereq 215* Hadwiger Major policies, political institutions, intergovernmental relations, and significant groups and coalitions active in non-metropolitan environments Policy arenas include education, poverty housing recreation, conservation and environment, research and extension, manpower, agriculture and farm policies

490. Independent Study. Cr var F S Special studies in the political institutions, processes and policies of American, foreign, and international governments Also, studies in traditional and behavioral political theory

A American Government and Politics
B Theory and Method
C Comparative Politics
D International Relations
E Extended credit The student may earn an additional 1 or 2 credits for extra study done for any 300- or 400-level course, with instructor's approval
H Honors
I Internship

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

501. Political Research. (3-2) Cr 3 F *Prereq 15 credits in political science* Hutter Principles of scientific empirical research applied to political data and public policies Research design, ethics, role of theory, types and sources of data Survey research, voting analysis, program evaluation, computer utilization, interviewing, review of algebra and the role of statistical techniques in research

510. State Government and Politics. (3-0) Cr 3 Alt F *Prereq 310* Wiggins. Comparative analysis of state political systems Role of interest groups, political parties, legislatures, courts, and governors in state politics Possible determinants of public policy outputs at the state level

511. (411 DL) Public Policy and Local Government. (3-0) Cr 3 Alt S *Prereq 310* Boles Graduate study in conjunction with 411 Not available for credit for students having taken 411

512. Urban Politics and Administration. (3-0) Cr 3 F *Prereq 311* Maney Structure and process of urban politics and the metropolitan political systems, problems in urban management and intergovernmental relations, theoretical perspectives on urban politics and policy

525. (425 DL) Public Law and Public Policy (3-0) Cr 3 Alt S *Prereq 320 or 420* Boles Graduate study in conjunction with 425 Not available for credit for students having taken 425

531. (431 DL) Development of Political Thought: Modern and Contemporary Political Thought. (3-0) Cr 3 S *Prereq 430* Shakeshaft Graduate study in conjunction with 431 Not available for credit for students having taken 431

543. Single-Party States (3-0) Cr 3 S *Prereq 6 credits in comparative politics* Moses Internal dynamics of single-party states Analysis of policy-making process, role of ideology, party membership, elite recruitment and promotion, and factors influencing prospects and directions of political change in a single-party state

547 Political Leadership and Elites (3-0) Cr 3 S *Prereq 6 credits in political science* Schmidt Various forms of leadership and leader-follower relations Obligations, exchanges, incentives, coercion, corruption, bossism in both the U S and foreign experience

549 Comparative Political Behavior (3-0) Cr 3 Alt F *Prereq 305 or 405* Rasmussen Empirical analysis of political behavior in cross-national perspective, including activist participation, level of political sophistication, cleavage structures and voting role of partisan identification

552 (452 DL) Comparative Foreign Policy (3-0) Cr 3 F *Prereq 251* Kihl McCormick Graduate study in conjunction with 452 Not available for credit for students having taken 452

559 International Relations Theory (3-0) Cr 3 S *Prereq 6 credits in international studies* Kihl McCormick Review analysis, and application of recent theoretical attempts to order systematically the field of international relations, especially lateral pressure, cyclical phenomena, decision making, and imperialism

560 Legislative Behavior (3-0) Cr 3 Alt S *Prereq 6 credits in American government* Wiggins Principles procedures, and problems of the legislative process Structure and organization of state legislatures and the U S Congress

561 The Chief Executive (3-0) Cr 3 S *Prereq 6 credits in American government* Hadwiger Legal and political forces influencing the U S president governors and other governmental executives in decision making, developing and administering programs of government, leading public opinion, and influencing legislation

571 Organizational Theory in the Public Sector (3-0) Cr 3 F *Prereq 6 credits in political science* Wessel Major theories of administrative organization, including motivations of administrators and organizations, comparisons of organizational arrangements, factors affecting organizational arrangements, and formal and informal decision-making structures

572. Public Budgeting and Financial Management (3-0) Cr 3 Alt S *Prereq 6 credits in political science* The process of public budgeting Alternative budget systems including taxation, the appropriation process, program evaluation, and debt and risk management at federal, state, and local levels

573. Public Personnel Administration. (3-0) Cr 3 Alt S *Prereq 6 credits in political science* Recruitment retention, and development of employees, merit systems, collective bargaining, and grievance procedures

574. Methods of Policy and Program Evaluation (3-0) Cr 3 S *Prereq 9 credits in political science* Lee Integration, application, and utilization of public administration and public policy concepts in the interpretation of results and effectiveness of public programs and the prediction of consequences for policymakers and administrators

576. (476 DL) Administrative Law. (3-0) Cr 3 S *Prereq Graduate classification* Boles Graduate study in conjunction with 476 Not available for credit for students having taken 476

578 (478 DL) Development Administration. (3-0) Cr 3 Alt F *Prereq Graduate classification* Olorunsola, Wessel Graduate study in conjunction with 478 Not available for credit for students having taken 478

580 (480 DL) Ethics and Public Policy (3-0) Cr 3 S *Prereq 6 credits in political science* Talbot Graduate study in conjunction with 480 Not available for credit for students who have taken 480

590 Special Topics. Cr 2 to 5 each time taken F S *Prereq 15 credits in political science, written permission of instructor*

A American Political Institutions
B Public Law
C Political Theory and Methodology
D Comparative Government
E International Relations
F Political Parties and Policy Formation
G Public Administration and Public Policy
I Internship
T Teaching Preparation

591 Seminar in the Teaching of American Government (3-0) Cr R F Preparation for college teaching Required of graduate students who are, or plan to become, teaching assistants in 215

599A. Research

599B. Creative Component.

Courses for Graduate Students, major or minor

610 Graduate Seminars (3-0) Cr 3 for each seminar F S *Prereq 15 credits in political science*

A American Political Institutions
B Public Law
C Political Theory and Methodology
D Comparative Government
E International Relations
F Policy Process
G Public Administration and Public Policy

Preprofessional Study

Requirements for admission to most professional academic programs can be met by study at Iowa State University These requirements may be met in the course of obtaining a bachelor's degree from Iowa State or at a level below that of a degree, depending on the intended field of study In some programs requiring three years of preprofessional work, a student may, by careful planning, complete requirements for the bachelor's degree upon transferring to Iowa State up to 32 semester credits* of professional course work

Students interested in preparing for professional study are encouraged to identify their interests early in their college careers by completing a preprofessional program form at registration When the choice of a professional field is made the student will have the assistance of an adviser who is familiar with the requirements of the appropriate professional schools The advising of preprofessional students is coordinated by the dean of the College of Sciences and Humanities, who can provide specific information concerning the preprofessional programs available at Iowa State University, admission to professional schools, and career planning for the professions

Bachelor's Degree Programs

Human Medicine. Most medical schools recommend a preprofessional background composed of a good foundation in the natural sciences (chemistry, biology, physics), mathematics, highly developed communication skills, and a rich background in the social sciences, arts, and humanities To obtain this background at Iowa State University, students should elect four years of preprofessional study leading to the bachelor's degree. Many medical schools admit a small number of exceptionally well-qualified students after 3 years of preprofessional study, in the 3-year degree program a student completes the third preprofessional year at Iowa State University and then transfers back to the University not more than 32 semester credits* from the professional program in partial fulfillment of the requirements for the bachelor's degree

Law. Nearly all accredited law schools now require an applicant to present a bachelor's degree with an excellent grade average for entry to the study of law. The bachelor's program should develop a high skill in creative thinking, comprehension and expression of ideas, and understanding of human institutions and values In a limited number of schools it is possible to receive a degree from Iowa State following three years of study here and completion of suitable credits in law It is also possible to combine a master's degree program with a degree in law In either case, early planning is required

Medical Technology. Usually working under the supervision of a physican in the medical laboratory of a hospital, clinic, industrial or pharmaceutical company, or in conjunction with a public health agency, the medical technologist performs clinical, microscopic, bacteriologic and other tests, types and cross matches blood, and, with specialization, may operate radioscopic and X-ray equipment The length of the preprofessional program is a minimum of 3 years of college education, with emphasis on biology and chemistry, followed by one year of professional education at an accredited hospital school of medical technology Students wishing to earn the bachelor's degree from Iowa State University may choose a 3-year or a 4-year preprofessional program In the 3-year degree program a student completes the third preprofessional year at Iowa State University and then transfers back to the university not more than 32 semester credits* from the professional program in partial fulfillment of the requirements for the bachelor's degree

Physical Therapy. Physical therapists work under the direction of physicians in administering therapeutic agents such as massage and exercise, heat, baths, light, and electricity Preprofessional education must include a minimum of 3 academic years of study, including strong backgrounds in the natural sciences, social sciences, and humanities After completing the preprofessional program, students transfer to a school of physical therapy, which is responsible for granting professional certification. In accordance with preplanning by the student, the bachelor's degree may be awarded by the institution offering the preprofessional program or the professional program Students wishing to earn the bachelor's degree from Iowa State University may choose a 3-year or a 4-year preprofessional program. In the 3-year degree program a student completes the third preprofessional year at Iowa State University, and then transfers back to the university not more than 32 semester credits* from the professional program in partial fulfillment of the requirements for the bachelor's degree

Physician's Assistant. The physician's assistant helps a primary-care physican by performing certain functions under the supervision of the latter These functions include taking patients' histories, making physical examinations, performing diagnostic and therapeutic tasks, administering follow-up care, and counseling with patients A background of health-care experience with direct patient contact, and a preprofessional education emphasizing basic sciences, are recommended for the professional program Length of the preprofessional program is a minimum of 2 academic years, followed by 2 years of professional study Successful completion of the 4 years can lead to the bachelor's degree from the professional school and certification as a physician's assistant Students wishing to earn the bacnelor's degree from Iowa State University may choose a 3-year or a 4-year preprofessional program In the 3-year degree program a student completes a third preprofessional year at Iowa State University, and then transfers back to the university not more than 32 semester credits* from the professional program in partial fulfillment of the requirements for the bachelor's degree

Speech-Language Pathology and Audiology. The Department of Speech (Communication Disorders) offers a preprofessional program in speech-language pathology and audiology leading to a Bachelor of Science degree in speech The field of study is concerned with the nonmedical diagnosis and remediation of communication disorders involving speech, language, and hearing problems The American Speech and Hearing Association serves as the national certifying organization for speech-language pathologists and audiologists, and requires the master's degree or its equivalent The curriculum consists of basic course work in the various facets of speech-language development and pathology, and audiology, as well as course work in disciplines such as psychology, child development, learning disabilities, zoology, and linguistics that provide a broad academic undergraduate background

Theology. All theological schools require a bachelor's degree for admission The American Association of Theological Schools recommends the following areas of study as the best preparation for theological studies English language and literature, history, including non-Western cultures, philosophy, natural sciences, social sciences, especially psychology, sociology, and anthropology, the fine arts, Biblical and modern languages, religion, both Western and Eastern Although students in a variety of major fields may qualify for admission to a theological school, interested students are advised to review their proposed programs with a representative of the Department of Philosophy or the Religious Studies Program

Programs With Bachelor's Degree Optional

Cytotechnology. A cytotechnologist usually works under the supervision of a pathologist, physican, or medical technologist in a medical laboratory Duties involve processing, staining, mounting, and evaluating cells from the human body to determine cellular variations and abnormalities that should be called to the supervisor's attention The length of the preprofessional program is a minimum of 2 years of college education, with emphasis on the sciences, followed by 12 months of professional study Students wishing to earn the bachelor's degree from Iowa State University may choose a 3-year or a 4-year preprofessional program In the 3-year degree program a student completes the third preprofessional year at Iowa State University, and then transfers back to the university not more than 32 semester credits* from the professional program in partial fulfillment of the requirements for the bachelor's degree

Dentistry. Although some dental schools accept a minimum of 2 years of college education as a requirement for admittance, most have more extensive preprofessional requirements oriented toward a liberal arts education Students are advised, therefore, to take at least 3 years of preparatory college work Students wishing to earn the bachelor's degree from Iowa State University may choose a 3-year or a 4-year preprofessional program In the 3-year degree program a student completes the third preprofessional year at Iowa State University, and then transfers back to the university not more than 32 semester credits* from the professional program in partial fulfillment of requirements for the bachelor's degree

Optometry. The optometrist detects and corrects abnormal vision without use of drugs or surgery, prescribes glasses, and detects evidence of eye diseases requiring referral to other health care practitioners The length of the preprofessional program is a minimum of 2 years of college education (which includes courses in biology, communications, physical sciences, social sciences, and the humanities) followed by 4 years of professional study This leads to the awarding of a professional degree by the institution offering the professional program Students wishing to earn the bachelor's degree from Iowa State University may choose a 3-year or a 4-year preprofessional program In the 3-year degree program a student completes the third preprofessional year at Iowa State University, and then transfers back to the university not more than 32 semester credits* from the professional program in partial fulfillment of the requirements for the bachelor's degree

Veterinary Medicine. Preveterinary medicine students may enroll in either the College of Agriculture or the College of Sciences and Humanities Many colleges of veterinary medicine require 3 years of preprofessional college education before admission to their professional program This permits students to gain a broader educational background while completing their preveterinary medicine requirements. In the College of Sciences and Humanities, with careful planning, the student may earn a bachelor's degree upon completion of the first year of study in a college of veterinary medicine For additional information see *Veterinary Medicine, Admission Requirements*.

Programs not Leading to the Bachelor's Degree from ISU

Dental Hygiene. The dental hygienist provides a variety of patient treatments and services prescribed by the dentist. The preprofessional program consists of two academic years of liberal arts, after which the student transfers to another institution which offers the professional program. Satisfactory compiation of this two-year program leads to the bachelor's degree from the professional institution.

Nursing. The registered nurse plans, gives, and evaluates nursing care and may direct others in giving this care. Iowa State University offers two years of preprofessional study, following which the student transfers to some other institution to seek the bachelor's degree and certification as a registered nurse. Students who plan to transfer to the College of Nursing at the University of Iowa, Iowa City (effective in summer session, first semester, or second semester) must file application forms with the University of Iowa during their sophomore year

Pharmacy. The pharmacist prepares and compounds medicines from prescriptions of physicians and, in some employment situations, may test and inspect pharmaceutical products To meet requirements of the professional program, students should take two years of preprofessional education If only one preprofessional year is elected, the student will need to take biology or physics in the first professional year offered in a college of pharmacy to which the student is admitted Successful completion of the 4-year professional program leads to the degree Bachelor of Science in Pharmacy, granted by the professional institution

*Students who are permitted fewer than 32 semester credits of academic work in their professional program must earn additional preprofessional credits to compensate for the difference

Professional Agriculture

Donald G Woolley, Chairman, Supervisory Committee

Supervisory Committee: C E Anderson, M D Boehlje, R L Willham

The major in professional agriculture is an off-campus program leading to the degree Master of Agriculture It is available to students who wish to pursue graduate study in agriculture without taking formal course work on campus The program is considered to be a terminal masters degree Those who major in professional agriculture are required to take a minimum of two courses in each of three disciplines and complete 24 semester credits of formal course work, as well as 4 semester credits for a creative component, and 4 semester credits of workshops Courses are offered in agricultural mechanization, agronomy, animal science, and economics Specific courses offered in the program and the location of the off-campus teaching sites may be obtained from the departmental course listings and by contacting the supervisory committee

As mentioned above, a minimum of four credits of creative component experience is required A thesis option is not available The creative component is a demonstration of independent creativity with a written report of laboratory, field, or library research acceptable to the student's program of study committee. Four workshops of one credit each are also required The workshop in applied statistics is mandatory Two of the workshops must be taken on campus

The program of study committee in consultation with the student will determine the courses to be taken and the acceptability of transfer credits and on-campus course work The major professor should be selected from the discipline where a concentration of course work will be taken

Students who wish to pursue this off-campus major must meet the same admission requirements as other students seeking admission to graduate study

For additional information students should communicate with the supervisory committee

Professional Studies in Education

J Stanley Ahmann, Chair of Department

Professors: Ahmann, Beavers, Boyles, Canute, Dilts, Engel, Gowan, Hohl, Hopper, Howe, Hunter, Jones, Kizer, Kniker, Lagomarcino, Lawrence, Manatt, Netusil, Pellegreno, Reschly, Smith, Thomas, Warren

Emeritus Professors: Bryan, Holmes

Associate Professors: Dalton, Ebbers, Hart, Huba, Jarchow, Miller, Ratcliff, Thielen, Wilson

Assistant Professors: Littrell, Sweeney

Graduate Study

Professional studies offers work for the degrees Master of Science, Master of Education, and Doctor of Philosophy with major in education and minor work to students taking major work in other departments Within the education major a student may specialize in adult and extension education, educational administration, counselor education, higher education, historical, philosophical, and comparative studies in education, research and evaluation, curriculum and instructional media The master's degree is the highest degree awarded in the elementary education and learning disabilities areas of specialization

Prerequisite to major graduate work in education is preparation substantially equivalent to the completion of one of the undergraduate curricula in education offered at Iowa State University, or graduate preparation in a discipline to be used as a teaching field in a community college or university, and adequate proof that the student ranks above average in scholastic ability and promise of professional competence

The foreign language requirement, if any, for the Ph D degree will be determined by the student's program of study committee If no foreign language is required, the total program must consist of a minimum of 78 semester hours, at least 16 of which must be earned outside the area of specialization Research tools such as statistics and research methods may not be included in the 16 hours Should foreign langugage be included, the program of study committee may adjust the minimum program requirement downward but in no instance may the required credit be less than 72 semester hours. Students whose native language is not English may substitute competence in English

Other graduate programs related to education (including General Graduate Studies) may be planned for students on the basis of previous education and experience as well as future plans and needs Students should refer to Agricultural Education, Home Economics Education, Industrial Education, Physical Education, and General Graduate Studies or to graduate-level course offerings within other departments

Open to graduate students for minor credit only Ad Ed 469

Adult and Extension Education (Ad Ed)

John P Wilson, Acting Section Leader

Course for minor graduate credit only

469 Introduction to Adult and Extension Education (3-0) Cr 3 F *Prereq 9 credits in education or related areas* An overview of adult and extension education its development, organizations, objectives, programs, and procedures Designed for prospective extension agents and other adult educators

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

536. Foundations of Adult Education. (3-0) Cr 3 F SS *Prereq 469* A study of the modern practice of adult education from the perspective of its history, philosophy, and literature

537 Teaching in Adult Education. (4-0) Cr 4 S SS *Prereq 469 or 536* Instruction and learning, theory, methods and techniques Development of approaches for teaching adults

538. Community and Adult Education (3-0) Cr 3 S *Prereq 536* Application and procedures adult educators utilize in the development of community based education programs Community education concepts, community needs, resources, leadership and services

539 Program Development in Adult and Extension Education. (3-0) Cr 3 F SS *Prereq 536.* Principles, models and evaluation of program planning processes

590 Special Topics. Cr 1 to 6 *Prereq 9 credits in adult and extension education*

591. Practicum/Internship. Cr 1 to 6 *Prereq 9 credits graduate work in adult and extension education* Practicum or internship designed for work exposure in adult and extension education Examples include continuing education centers, community colleges extension offices, training divisions, etc

593 Workshop. Cr 1 to 3 *Prereq* 536 Workshops designed to provide intensive, concentrated, and experience-oriented exposure to a special adult and extension education topic

595. Colloquium in Adult and Extension Education Cr 1 to 3 *Prereq 6 credits in education* Offered when demand warrants

A Adult Basic Education
B Adult Counseling
C Educational Gerontology
D Dynamics of Instructional Groups
E International Adult Education
F Adult Training in Life/Career Planning
G Nontraditional Education
H Philosophy of Adult Education
I Training Skills
J Administration of Adult Vocational Education

Courses for Graduate Students, major or minor

601. Theory Building in Adult Education. (3-0) Cr 3 *Prereq: 536, 537, 538, 539* Examination of what is theory and developing theory in adult education

615. Seminar (1-0) Cr 1-3 F S SS *Prereq 10 credits in adult and extension education, permission of instructor* Group study and discussion on student and staff research in adult and extension education

699. Research. Cr arr F S SS *Prereq: 10 credits in adult and extension education, permission of instructor*

Counselor Education (Co Ed)

Gordon Hopper, Section Leader

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

530 Human Interaction and Learning. (3-0) Cr 3 F S SS *Prereq 8 credits undergraduate education, sociology, or psychology*. An overview of research, theory, and conditions that facilitate behavioral change in individuals and within institutions Classroom instruction and assignments are planned so students can relate their individual needs to professional role expectations

532. Guidance in the Elementary School. (2-0) Cr 2 F SS *Prereq 8 credits undergraduate education, sociology, or psychology* Introduction to current counseling, coordinating, and consulting practices as they relate to students, parents, and professionals in the elementary school

Courses for Graduate Students, major or minor

534 Development, Management and Evaluation in Guidance (2-0) Cr 2 S *Prereq: Co Ed 530*. Proactive involvement in defining, delivering, scheduling, and evaluating guidance services in a school setting Leadership styles, public relations, and identifying and working within the school and community power structure in relation to establishing and redefining guidance service objectives Methods of evaluating the impact of guidance services

538. Cross Cultural Issues in Counseling. (2-0) Cr 2 Alt SS, offered 1982 *Prereq. Co Ed 530* Biases of self, others, and institutions with strategies for change

551 Occupational Choice and Development. (2-0) Cr 2 F Alt SS, offered 1983 *Prereq: Co Ed 530* Career development and choice factors influencing career choice, classification systems, types of informational materials, putting informational materials to use in various settings

555 Use of Assessment Instruments in Counseling and Consulting (2-0) Cr 2 S Alt SS, offered 1982 *Prereq Co Ed 530, Re Ed 550* Measurement principles involved in applying and interpreting data gathered by assessment instruments, types of assessment instruments available, selection of appropriate instruments for use with different populations. Includes supervised experience using different modes of relating assessment data to students, faculty, and parents

560 Theories of Counseling. (2-0) Cr 2 F SS *Prereq 530* Current approaches to counseling for facilitation of choice and/or behavorial change

561 Counseling Techniques: Adolescent and Young Adult. (2-1) Cr 2 F SS *Prereq Concurrent enrollment in 560 or Co Ed 560* Application of theory to practice through exposure to didactic and laboratory work with clients The laboratory portion stresses skill building in listening and responding, identifying barriers to change and planning intervention strategies.

565 Counseling Techniques: Preadolescents. (2-0) Cr 2 F *Prereq Credit or classification, Co Ed 560* Applied use of role playing, fantasy, classroom groups, relaxation, and other specific techniques that can be utilized as a means for assisting the preadolescent with self understanding, problem solving and other developmental concerns

570 Theories of Group Procedures. (2-0) Cr 2 S SS *Prereq Co Ed 560* Current group counseling approaches for facilitation of choice and/or behavioral change

571 Laboratory Experience in a Counseling Group. (0-2) Cr 1 F S *Prereq Co Ed 570* Enrolled students will be participants in a counseling group Offered on a satisfactory-fail basis only

580 Practicum in Counseling. (2-8) Cr 4 F S *Prereq Co Ed 561 or 565* Designed for students who desire counseling experience in a nonschool setting Practicum experience can be arranged at urban centers, detention facilities, MDTA centers, vocational rehabilitation centers, etc

581 Practicum in Secondary School Counseling. (2-8) Cr 4 F S *Prereq Co Ed 561* Placement in a secondary and /or junior high school The practicum student will perform various role functions expected of the school counselor Emphasis on individual and group counseling functions.

582. Practicum in Elementary School Counseling. (2-8) Cr 4 F S *Prereq Co Ed 565* Placement in an elementary school Counseling students, consulting with teachers and parents and coordinating activities that enhance student development and growth both in the cognitive and affective domains

590. Special Topics. *Prereq 10 graduate hours in counselor education*
A Creative Component, Cr 1-2
B Independent Study, Cr 1-2

593. Workshop in Counseling and Guidance. (3-0) Cr 2 SS *Prereq 10 hours in counselor education* Workshops are designed to give practicing school counselors an in-depth exposure to a counseling model with concurrent opportunity for application of the model

Courses for Graduate Students, major or minor

610. Group Counseling Practicum. (2-2) Cr 1 F S *Prereq Co Ed 580, or 581, or 582* Supervised experience facilitating and processing counseling groups

611 Advanced Counseling Practicum. (2-8) Cr 4 F S SS *Prereq Co Ed 580, or 581, or 582* An advanced practicum experience primarily designed for doctoral students Practicum placement can be made in a variety of settings

615 Seminar (1-3-0) Cr 1-2 F S *Prereq 10 hours in counselor education* Seminars are designed to meet the needs of practicing school counselors and doctoral students

620. Supervision of Counseling Practicum (1-6) Cr 2 F S *Prereq Minimum of 6 practicum credits* Designed to give doctoral students the experience of supervising M S level practicum and leading a practicum seminar Individual sessions with M S level practicum students for critique of taped counseling sessions and supervision of other practicum activities through planning, discussion, and on-site visitation

699. Research. Cr arr *Prereq 10 credits in counselor education*

Curriculum and Instructional Media (Curr)

Lynn W Glass, Section Leader

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

501. Principles and Practices of Educational Media. (3-0) Cr 3 F SS *Prereq Graduate classification* Volker, Simonson Organization of educational media centers in school and industrial settings Analysis of types of hardware and software necessary to design, produce, present, and evaluate instruction with media Application of research findings relative to media and learning Preparation of a variety of teaching materials

502. Producing Visual Media. Cr 2-4 S *Prereq Curr 501* Volker, Simonson Principles of composition and design of visual instructional media as applied to still photography, film production, video tape production, or instructional graphics Laboratory work in production of these media and analysis of research on the design, production and utilization

503. Designing Instructional Systems. (3-0) Cr 3 S *Prereq Curr 501* Volker, Simonson Designing, scripting, and producing instructional systems for individual and group instruction Application of principles of programmed instruction Analysis of past and current developments in teaching machines, computer-assisted instruction, and instructional development. Methods for evaluating instructional strategies

504. Managing and Evaluating Media Programs. (3-0) Cr 3 F *Prereq Curr 501* Volker, Simonson Principles and procedures for analysis of a media program in an education setting Methods for gathering data, developing and evaluating job descriptions, and analyzing budget, personnel distribution, organization of resources, circulation and production procedures, and physical facilities Development of in-service and public relations programs for selected media centers

511 Teaching Assistant's Orientation Seminar. (1-1) Cr 1 F S *Prereq Graduate classification* Volker, Simonson Survey of basic techniques of college teaching for graduate teaching assistants who have no background in teaching Videotaped microteaching experiences emphasizing methods of lecturing, conducting discussion, questioning and reinforcement are included, as well as simple media production and classroom testing and evaluation

512. Strategies for Classroom Teaching. (2-3) Cr 3 F *Prereq Graduate standing* Volker Thoretical basis and practical experience in the design, production, presentation, and evaluation of a body of knowledge in a specific content area. Behavioral objectives, production of media, microteaching, and methods for handling large group, small group, and individualized instruction

542. The Secondary School Curriculum. (2-0) Cr 2 F SS *Prereq Teacher certification* Dilts, Glass, McNally-Jarchow Curricular and co-curricular programs of secondary schools, recent trends in goals, content organization, and organization for instruction, local community resources as curriculum content

545 The Elementary School Curriculum. (2-0) Cr 2 F SS *Prereq Teacher certification* Dilts, Glass, McNally-Jarchow Curricular and co-curricular programs of elementary schools, recent trends in goals, content organization, and organization for instruction, local community resources as curriculum content

590. Special Topics. Cr 1-3 *Prereq 9 credits of graduate work in education*
A Curriculum
B Instructional Media
C Science Education
D Secondary Education

591. Supervised Field Experience. Cr 1-3 *Prereq 9 credits of graduate work in education* Supervised on-the-job field experience in special areas

593 Workshops. Cr 1-3 *Prereq 9 credits of graduate work in education*
A Curriculum
B Instructional Media
C Science Education
D Secondary Education

594 Principles of Curriculum. (3-0) Cr 3 F Alt SS, offered 1983 *Prereq. Teacher certification* Dilts, Glass, McNally-Jarchow Orientation to the school curriculum, definitional, theoretical and historical consideration of the curriculum, representative curriculum models and theorists

596. Problems of Curriculum. (3-0) Cr 3 S Alt SS, offered 1982 *Prereq 6 credits of graduate work in education* Dilts, Glass, McNally-Jarchow An analysis of curriculum theories and principles of curriculum construction and evaluation, models in the areas of assessment, development and implementation, sociocultural factors affecting the curriculum

Courses for Graduate Students, major or minor

615. Seminar (0-2) Cr 1 F S SS *Prereq Teacher certification* Staff Selected topics in curriculum and instructional media, an analysis of research potential, evaluation of impact upon the profession, implications for additional research

663. Analysis of Teaching. (2-0) Cr 2 S *Prereq 6 credits of graduate work in education* Dilts, Glass, McNally-Jarchow Critical examination of various systems for studying and evaluating teaching, descriptive studies and conceptual systems of teaching; their nature and possible uses, major research attempts to assess teaching effectiveness along with ensuing problems connected with such efforts

699. Research. Cr arr *Prereq 9 credits of graduate work in education*
A Curriculum
B Instructional Media
C Science Education
D Secondary Education

Educational Administration (Ed Adm)

Richard Manatt, Section Leader

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

541. Principles of Educational Administration. (3-0) Cr. 3 F SS *Prereq. Sec Ed 426. Psych 333.* Engel, Boyles. Philosophy and purposes of education in a democratic society Basic principles of school administration. Analysis of the nature and function of units of education at local, intermediate, and state levels, exploration of substantive elements such as school finance. Analysis of administrative skills and individual assessment of those skills

543. The Administration of School Personnel I. (3-0) Cr 3 Alt F SS *Prereq: 9 credits in education* Engel Evolution of the labor management relationship Selection and deployment of the teaching and administrative staff, personnel policies, assignment, staff development, and salary administration

546. School Business Management. (2-0) Cr 2 SS *Prereq 541* Hart Fiscal administration at the district and building level, functions and duties of the business manager; maintenance and operations, insurance, debt service, purchasing, district energy management, and budgeting

548. Educational Policy Making and Interpretation (3-0) Cr 3 S SS Prereq 541 Boyles, Engel Functions of policy making in education, current issues in educational policy making at the local, state, and national levels, problems of implementing and interpreting policy to the community Power structure in the community and its relationship to the educational process Techniques and practices of public relations in the policy making and administrative functions of a school district

549. Planning Public School Facilities. (3-0) Cr 3 F *Prereq 541* Hart Assessment of facility needs, selection of an architect, educational specification, site selection and acquisition, schematic design and design development, contract documents and the bidding process, the construction phase, remodeling, and retrofitting for energy conservation

557. Supervision of Instruction — Elementary and Secondary Schools. (3-0) Cr 3 F SS *Prereq 9 credits in education* Manatt, Hohl Purposes of educational supervision review of contemporary methods of teaching, common techniques of supervision, evaluation of teaching and learning

575 Fundamentals of School Law. /3-0) Cr 3 S *Prereq 541 543* Engel Constitutional, statutory, and judicial provisions as a basis for the legal operation of public schools The law is examined as it affects the local school district, boards of education, administrators, teachers, and students at the elementary and secondary school levels

576. The Administration of Elementary Schools. (3-0) Cr 3 F SS *Prereq 557* Hohl Patterns of elementary school organization, educational leadership through supervision, curriculum development, and in-service education Administering pupil and auxiliary services, staff and community relations

577 The Administration of Secondary Schools. (3-0) Cr 3 S SS *Prereq 541* Manatt, Engel Secondary school organization, schedule making, management of pupil organizations, evaluation of pupil growth Evaluation of the total program, staff utilization, and leadership

590 Special Topics. Cr 1 to 4 *Prereq 9 credits in education*

591. Supervised Field Experience. Cr 1 to 6 *Prereq 15 credits graduate work in special areas* Supervised on-the-job field experience in special areas

593. Workshops. Cr 1 to 4 *Prereq 9 credits in education*

Courses for Graduate Students, major or minor

615. Seminar. (1-3-0) Cr 1 to 3

641. Administrative problems. (3-0) Cr 3 S *Prereq 541, 543* Engel A case study approach to the resolution of problems in educational administration Emphasis on decision-making, conflict resolution, and communication using actual situations

643. The Administration of School Personnel II. (2-0) Cr 2 F *Prereq 543.* Engel All aspects of collective bargaining in the public sector Selected topics such as affirmative action, legal aspects of personnel administration, evaluation of administration, and staff welfare

644. Educational Finance. (3-0) Cr 3 S *Prereq 541* Hart State and local tax structure in support of public education; federal programs, assessment practices; disparities in wealth among school districts, suitability of the property tax for local use, development of theoretical models of state aid formulas, practical application of the proportionate sharing formula and the foundation plan; and Iowa State aid formula

678. Administrative Theory in Education. (3-0) Cr 3 F *Prereq: Master's degree, permission of instructor* Manatt. Historical background of current thinking in administration and organization, theoretical approaches to administration; analysis of functions and processes of administration as they apply to education

679. Advanced Administrative Theory in Education. (2-0) Cr 2 S *Prereq 678* Manatt Critical evaluation of the major research in systems analysis, operations research, and prediction models as they apply to the management of schools and colleges, staff development techniques and theories, models and cases of organization development

699 Research Cr arr *Prereq 9 credits in education*

Higher Education (Hg Ed)

James Ratcliff, Section Leader

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

544. Planning Facilities for Higher Education (2-0) Cr 2 S *Prereq Graduate standing* Includes the feasibility study, planning team and planning process, site selection, specifications, schematic design, contract documents and bidding, construction, remodeling, and energy conservation

560. Higher Education in the United States. (3-0) Cr 3 F SS *Prereq Graduate standing* Historical development, diversity, functions, and problems of institutions, federal programs, basic and applied research, innovative colleges, graduate education, philosophies, trends, and issues A prerequisite for other courses in higher education

561 Methods of College Teaching (2-0) Cr 2 F *Prereq 6 graduate credits* Educational theory and methods relating to college teaching Requisite abilities and responsibilities of the contemporary college teacher

562. Curriculum and Instruction in Higher Education. (3-0) Cr 3 S *Prereq 560* Models of curriculum design, writing educational objectives, liberal, general, career, and professional education, improvement of instruction, non-traditional education

563. College Personnel Policies and Practices. (3-0) Cr 3 Alt SS *Prereq 560* Personnel management and problems, in-service development salaries and fringe benefits, promotions, tenure, retirement, and recruitment practices Faculty organizations and collective bargaining

567 The Comprehensive Community College (3-0) Cr 3 Alt S,SS *Prereq Graduate standing* The community college as a unique institution its historical development, goals and purposes, organization, programs, and specific characteristics

574 Student Personnel Services in Higher Education (3-0) Cr 3 F *Prereq: Credit or classification in 560* An introduction to the field of student personnel work with a consideration of student activities, counseling services, financial aids, admissions, student conduct, and residential programs, includes community college programs

575. Organization and Administration of Student Personnel Services. (2-0) Cr 2 S *Prereq 574* Organization structures, role and function of student personnel staff, policies and decision-making for student personnel services

576. Student Development in Higher Education. (2-0) Cr 2 S *Prereq. 574* The student development approach to student personnel work Theories of student development and their applications in student personnel programs, services, and activities Implications of developmental theories in reference to current student issues such as career planning, academic programs, and moral development will be discussed

580. Current Topics in Community Colleges. (1-3) Cr 1 to 3 *Prereq Graduate classification* Topics adjusted to specific needs of colleges For off-campus

590. Special Topics. Cr 1 to 4 *Prereq 9 credits in education.*

591. Supervised Field Experience. Cr 1 to 4 *Prereq 10 credits graduate work in special area* Supervised on-the-job field experience in special areas.

593. Workshops. Cr 1 to 5 *Prereq 15 credits in education*

Courses for Graduate Students, major or minor

615. Seminars in Higher Education. Cr arr SS (C)
A. Student Services
B Community Colleges
C Current Issues

688. College Organization and Management. (3-0) Cr 3 S *Prereq 560* Administrative organization and behavior, communications, leadership, distribution of power, institutional governance Financial administration including fund-raising, budgeting, management of sponsored research and special programs

699 Research Cr arr *Prereq 9 credits in education*

Historical, Philosophical, and Comparative Studies in Education (HPC Ed)

George Kizer, Section Leader

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

580 Bibliographic Research Techniques (2-0) Cr 2 Alt S, offered 1983 *Prereq 9 credits in education* Kizer In-depth study of sources and techniques of bibliographic research in education

581 Philosophy of Education (3-0) Cr 3 F S SS *Prereq 9 credits in eduction* Kizer Philosophical traditions of the ancient and medieval worlds Traditions of the modern world Classification and analysis of contemporary American educational philosophies and theories

583. Teaching in the Affective Domain. (3-0) Cr 3 SS *Prereq 9 credits in education* Kniker Value theories techniques for improving student motivation and strengthening educational relationships analysis of affective and aesthetic education curriculum, assessment of affective objectives

584 History of European Education (3-0) Cr 3 Alt SS offered 1983 *Prereq 9 credits in education* Kizer Kniker, Smith Educational practices and institutions in ancient Greece and Rome, medieval educational patterns, rise of university, impact of the Renaissance national systems of education

585 Comparative Education — European (3-0) Cr 3 S, offered 1982 *Prereq 9 graduate credits* Smith Development, principles, and uses of comparative education, comparison of the principles, practices and institutional forms of education in selected European countries, the United Kingdom, France, the U S S R Sweden, Denmark, both Germanies, Italy, and Spain recent movements for reform and innovations

586. Comparative Education — Non-European (3-0) Cr 3 Alt SS, offered 1982 *Prereq 585* Smith Conflicting theories of the role of education in development, educational systems, practices, and issues in selected non-European countries — e g , China, Japan, India, the Philippines, efforts at international educational assessment

588. History of American Education (3-0) Cr 3 F *Prereq 9 credits in education* Kizer, Kniker, Smith Interpretations of American schooling, including revisionism, study of European roots of colonial education, development of common school, selected educational reforms of the 19th and 20th centuries Extensive use of primary sources and biographical data

590. Special Topics. Cr 1 to 5 *Prereq 9 credits in education*
A. History of Education
B Philosophy of Education
C Comparative Education

591 Supervised Field Experience. Cr 1 to 6 *Prereq 10 graduate credits in special area* Supervised on-the-job field experience in special areas

593. Workshops. Cr 1 to 5 *Prereq 9 credits in education*

Courses for Graduate Students, major or minor

602. Current Educational Issues. (3-0) Cr 3 S SS *Prereq 9 credits in education* Kizer A study in depth of selected educational issues, movements, or problems in contemporary American education

603. Philosophical Ideas in American Education. (3-0) Cr 3 Triennial S, offered 1984 *Prereq 601* Kizer An intensive analysis and criticism of selected educational theories and philosophies Synthesis and evaluation of their bearing on educational theory and practice

615. Seminar. (1 to 3-0) Cr 1 to 3 S
A History of Education
B Philosophy of Education
C Comparative Education

699 Research Cr arr *Prereq 9 credits in education*

Research and Evaluation (Res Ev)

Anton Netusil, Section Leader

Courses Primarily for Graduate students, major or minor, open to qualified undergraduates

550. Basic Educational Research with Statistical Application (3-0) Cr 3 F S SS *Prereq 9 credits in education* Introduction to educational research methodology, application of fundamental statistical concepts and basic procedures for analyzing educational data Designed primarily for educators doing non-thesis work

552 Beginning Educational Statistics and Research. (3-1) Cr 3 F SS *Prereq 9 credits in education, and 550 or 3 credits in mathematics* Statistical concepts and procedures for analyzing educational data Introduction to educational research design and descriptive statistics with educational computer applications

553. Intermediate Educational Statistics. (3-1) Cr 3 S SS *Prereq 552* A continuation of statistical concepts and procedures for analyzing educational data Inferential techniques with educational computer applications

557 Computer Applications in Education. (3-0) Cr 3 F SS *Prereq 550 or 552* Use of computers in processing educational research data including experiences utilizing statistical packages such as SPSS and a general purpose language such as PL/1 Data coding data representation and conversion, files, computer organization, and job control language

560 Principles of Evaluation. (2-0) Cr 2 F S SS *Prereq 550* Training in the development and/or interpretation of appropriate evaluation procedures and evaluation models Discussion of relevant topics such as norm vs criterion referencing, domain referenced tests, competency testing, grading practices, etc

561 Program Evaluation. (2-0) Cr 2 F SS *Prereq 550* Techniques of conducting an evaluation of instructional programs A variety of evaluative models will be explored and the student will apply at least one such model to an on-going program

590 Special Topics Cr 1-3 each time taken F S SS *Prereq Permission of instructor* Guided reading and or study on special topics Two hours normally given for creative component work

593 Workshop. Cr 1-3 each time taken Offered when demand warrants *Prereq Permission of instructor* Intensive, concentrated exposure to a special educational research or evaluation problem

Courses for Graduate Students, major or minor

615 Seminar (1-0) Cr 1 *Prereq 3 credits in research and evaluation, permission of instructor* Group study and discussion on a wide variety of topics in research and evaluation

654 Advanced Educational Research and Design. (3-0) Cr 3 F S SS *Prereq 553* Advanced research methodology and design of experiments Problem selection, design, measurement, statistical analysis, and interpretation of data Applicable for thesis or dissertation research

699 Research Arranged F S SS *Prereq Permission of instructor*

Psychology

David C Edwards, Chair of Department

Professors: Ahmann, Avant, Bath, Borgen, Brown, Charles, Edwards, Hannum, Kahn, Karas, Layton, Lewis, Menne, Muchinsky, Peters, Reschly, Russell, Schuster, Strahan, Tumage, Warman, Wolins, Zytowski

Professors Emeritus: Fritz

Associate Professors: Andre, Hughes, Krulewitz, Lando, Mason, Phye, Scott

Assistant Professors: Epperson, Gibbons, Gresham

Instructor: Hinz

Undergraduate Study

For the undergraduate curriculum in sciences and humanities, with major in psychology, leading to the degree Bachelor of Science, see *Sciences and Humanities, Curriculum*

Psychologists are concerned with behavioral research, teaching, and applications of research in a variety of settings

An undergraduate major in psychology may be taken as general education or as preparation for graduate study Undergraduate psychology majors who have concurrent majors with other departments such as sociology, business administration, or family environment may qualify for certain positions in industrial-personnel and social welfare systems as well as for professional work in correctional, rehabilitation, and retardation centers Such diversified education must be planned early in the undergraduate's career and in close consultation with an adviser Professional work in psychology requires graduate degrees

A program of study that meets the needs and interests of the student and the department will be developed in consultation with the adviser Departmental requirements for all students and suggested courses for students with certain specified goals are set forth in a brochure available from advisers.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with major in psychology, and minor work to students taking major work in other departments A two-year Specialist degree program is offered in school psychology

Students desiring a graduate major in psychology must have been graduated from an accredited college in a curriculum substantially equivalent to the undergraduate curriculum in sciences and humanities at Iowa State University Prerequisite to admission is at least 15 credits of basic psychology, which should include a laboratory course and a measurement-statistics course

The department also participates in the interdepartmental program of Industrial Relations (see Index)

A formal class and a supervised practicum in the teaching of psychology is required of all doctoral degree candidates and strongly recommended for master's level students whose future plans may include teaching at the college level

Open to graduate students for minor credit only 311L, 401, 422, 425, 430, 431, 434, 436, 440, 450, 451, 460

Courses Primarily for Undergraduate Students

101 General Psychology. (3-0) Cr 3 F S SS Introduction to fundamental psychological concepts derived from the application of scientific method to the study of behavior Applications of psychology 101H F Honors section (For students in the university honors program only)

131 Academic Learning Skills. (2-0) Cr 1 F S.SS Efficient methods of study and reading Offered on a satisfactory-fail basis only

230. Developmental Psychology (3-0) Cr 3 F S SS Characteristic development and decline of physical traits, learning and intelligence, social and emotional behavior, personality and adjustment from conception to senescence Emphasis on childhood and adolescence 230H S Honors section (For students in university honors program only)

250 Consumer Psychology. (3-0) Cr 3 F S.SS Theory and application of psychological principles to consumer behavior, including marketing, decision-making, sales promotion, various factors influencing buying, the purchase process, and consumerism Introduction to consumer surveys and motivation research

280. Social Psychology (3-0) Cr 3 F S SS *Prereq 101* Individual human behavior in social contexts. Emphasis on attitudes, perception of others, social influence, attraction, aggression, and small group behavior, such as conformity, power, leadership, status, norms

301 Research Design and Methodology. (3-0) Cr 3 F S SS *Prereq Stat 101, 2 courses in psychology* Rationale underlying procedures for control and manipulation of experimental variables in psychology research Designs appropriate for various research questions Laboratory experience in designing research, collecting and evaluating data, and preparing research reports

311. Brain and Behavior. (3-0) Cr 3 F S.SS *Prereq 101, Biol 109 or 110 or Zool 155* Survey of basic concepts in the neurosciences with emphasis on brain mechanisms mediating sensory processes, arousal, motivation, learning, and abnormal behavior

311L. Laboratory in Brain and Behavior. (0-4) Cr 2 S *Prereq Credit or classification in 311* Techniques of stereotaxic surgery on the rat lesions, electrical and chemical stimulation of the brain Behavioral analysis and histological evaluation of brain manipulations

312. Perception — Information Processing. (3-0) Cr 3 F S SS *Prereq 101* Functioning of the human perceptual systems as the brain processes information through those systems Emphasis on vision and audition

313. Learning. (3-0) Cr 3 F SS *Prereq 101* Fundamental concepts and principles of learning Consideration of data from human and animal experimentation

314. Motivation. (3-0) Cr 3 F S *Prereq 101* Concepts and topics of motivation including curiosity, arousal, emotion, sex, aggression, drive, instinct, sleep, fatigue, and work

315. Drugs and Behavior. (3-0) Cr 3 S *Prereq 101, Biol 109 or 110 or Zool 155* Fundamentals of psychoactive drugs and their use in experimental, therapeutic, and social settings

316. Cognitive Processes. (3-0) Cr 3 F *Prereq 101* How humans process and use information in thinking, problem solving, and using language Fundamental processes in perceiving, coding, storing, and retrieving information from short term and long term memory

333. Educational Psychology. (2-1) Cr 3 F S.SS *Prereq 230 or C.D 226.* Human learning with particular reference to applications in educational settings, intellectual, personal, and social influences on the learning process; measurement and evaluation of educational outcomes

346. Psychology of Women. (WS 346) (3-0) Cr 3. S *Prereq: 2 courses in psychology including 101* Survey of psychological literature relating to biological, developmental, interpersonal, and societal determinants of the behavior of women

350. Human Factors. (3-0) Cr 3. F *Prereq 101* Survey of human factors, interaction of people with machines, or engineering psychology System performance, human errors, interface requirements, research needs, personnnel requirements, accident prevention, environmental concerns of household and workspace

360. Psychology of Normal Personality. (3-0) Cr 3 F S SS *Prereq 101* Theories and research in the study of development and functioning of normal personality

381 Social Psychology of Small Group Behavior. (Soc 381) (3-0) Cr 3 S *Prereq 280 or Soc 305* A survey of small group research and theory from a social psychological perspective Major theories of interpersonal behavior such as exchange theory, equity theory, and status consistency theory, and major areas of research such as leadership, power, conformity, bargaining, status, norms, and roles

382. Environmental Psychology (3-0) Cr 3 F *Prereq 101* Survey of current psychological research and theory on the effects of the environment on human behavior Both the physical and social environment will be considered as they relate to mood, prosocial and antisocial behavior, stress, and interpersonal relations

401 History of Psychology (3-0) Cr 3 S *Prereq 4 courses in psychology* American psychology development including its philosophical origins, schools of thought, and modern theoretical viewpoints

413. Psychology of Language. (3-0) Cr 3 Alt S offered 1982 *Prereq 101, and Engl 219 or Anthr 221* Psychological processes involved in primary linguistic activities (speaking and listening) and secondary linguistic activities (writing and reading)

422. Counseling Theories and Techniques. (2-2) Cr 3 F S *Prereq 3 courses in psychology including 460* Survey of major theoretical approaches in counseling and supervised practice in the specific skills and techniques employed

425. Principles and Methods of Interviewing (2-2) Cr 3 F *Prereq 4 courses in psychology* Selection supervisory, case-history, counseling, and market-research interviews Ethics of interviewers Laboratory experience with design of questionnaires, questioning, listening, and confronting

430. Psychology of Adolescence. (3-0) Cr 3 F S SS *Prereq 2 courses in psychology including 230* Developmental characteristics of the adolescent, examination of antecedents of behavior with a goal of better understanding of this age group, implications for education and guidance

431 Psychology of Maturity and Old Age (3-0) Cr 3 F *Prereq 3 courses in psychology including 230* Psychologically important structural and functional changes in the human from maturity to old age Typical as well as individually unique psychomotor cognitive and socioemotional development and decline

434 Principles of Behavior Modification (3-0) Cr 3 S *Prereq 313 or 333* Basic principles and applications of behavior modification procedures with emphasis on applied settings such as classrooms, institutions and families Consideration of appropriate uses and ethical concerns

436 Psychology of the Exceptional Individual (3-0) Cr 3 F S SS *Prereq 230, 333, 440* Behavioral characteristics, problems, and needs of a wide variety of atypical persons, including the gifted

440. Psychological Measurement I. (3-0) Cr 3 F S SS *Prereq 9 credits in psychology, Stat 101* Principles of psychological measurement, including concepts of reliability and validity, interpretation of test scores factors influencing test performance, construction and interpretation of maximal and typical performance measures, uses and misuses of tests

450 Industrial Psychology (3-0) Cr 3 F S SS *Prereq 2 courses in psychology including 101* Content and methods of industrial psychology Selection and placement techniques, performance appraisal, training, testing in industry, techniques of interviewing, human error, accidents, and job analysis

451 Organizational Psychology (3-0) Cr 3 F S *Prereq 2 courses in psychology including 101* Content and method of organizational psychology Emphasis on organizational theory, structure of organizations, motivation, leadership, job satisfaction, communication, problem solving, and decision making

460. Abnormal Psychology. (3-0) Cr 3 F S SS *Prereq 3 courses in psychology including 101* Description of major forms of maladaptation including neuroses and psychoses. Factors in the development of behavior deviations Research pertinent to the description, development, and maintenance of abnormal behavior

490 Independent Study Cr var F S SS *Prereq Permission of instructor, junior classification*
A Supervised Reading
B Supervised Research *Prereq 301*
C Fieldwork of Practicum
D Seminar
H Honors

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates.

508. Research Methods in Applied Psychology (3-0) Cr 3 Alt S offered 1983 *Prereq 440, Stat 402* Research methods in natural and controlled environments, cross-sectional and longitudinal studies, observational and correlational approaches, experimental and quasiexperimental designs, single subject research procedures, time-series designs, studies of intact groups, evaluation of applied programs, person-situation interactions, metaanalytic research procedures

511. Advanced Physiological Psychology (3-0) Cr 3 Alt F offered 1981 *Prereq 311* Neurophysiological correlates of behavior

512 Advanced Perception (3-0) Cr 3 Alt S offered 1982 *Prereq 312* Historical and modern information processing approaches to theory and research in vision and audition

513. Advanced Animal Learning (3-0) Cr 3 Alt F offered 1982 *Prereq 313* Examination of empirical and theoretical issues of classical and instrumental conditioning

514 Advanced Human Learning, Memory, and Cognition (3-0) Cr 3 Alt S offered 1983 *Prereq 316* Historical and contemporary survey of human symbolic behavior, thinking, and conceptual behavior

517 Psychopharmacology (3-0) Cr 3 Alt F offered 1981 *Prereq 511* Fundamentals of drug-behavior interactions with emphasis on psychoactive drugs and their use in experimental, therapeutic, and social settings

530 Life Span Developmental Psychology (3-0) Cr 3 S SS *Prereq 4 courses in psychology, including 230* Psychological changes in human behavior from conception to senescence in physical, sensory, intellectual, emotional, and social development Intensive consideration of theories, issues, and data central to a life-span model of development, major longitudinal studies emphasized

533. Advanced Educational Psychology. (3-0) Cr 3 F SS *Prereq 3 courses in psychology, including 333* Human learning and cognition with reference to application in educational settings Emphasis on the effects of learner characteristics such as intellectual, personal, and social development on the learning process Consideration given to instructional theory and models

536 Mental Retardation (3-0) Cr 3 S SS *Prereq 436* Psychological characteristics of the mentally retarded including theoretical views and research on etiology, prevalence, learning, adjustment, clinical practices, and educational programs Emphasis on current issues such as recent litigation, bias in assessment, labeling effects and assessment of adaptive behavior

537 Psychological Characteristics of Giftedness. (3-0) Cr 3 Alt S offered 1982, Alt SS offered 1983 *Prereq 3 courses in psychology, including 230* Cognitive and affective development of giftedness throughout the life-span Giftedness as a generic term includes the intellectually superior, the talented, and the creative Emphasis on current theoretical views and research in cognition and problem solving, as well as social-emotional adjustment

540 Psychological Measurement II (3-0) Cr 3 S *Prereq 440, Stat 401* Nature of psychological measurement Measurement and scaling theory Theoretical and statistical definitions of reliability and validity Introduction to multivariate methods including factor analysis

542. Psychoeducational Assessment. (4-0) Cr 4 F SS *Prereq 440* Theory and research concerning assessment of intelligence and achievement with emphasis on developmental patterns and diagnosis of learning problems Critical examination of current assessment practices in clinical and educational settings

544. Practicum in Assessment. *Prereq 542 and permission of instructor* Supervised practice in administering, scoring, interpreting, and reporting individual tests
A WISC-R and Stanford-Binet (1-2) Cr 1 F
B McCarthy and ITPA (1-2) Cr 1 S
C WAIS and Multiple Aptitude Tests (1-2) Cr 1 F

550 Advanced Industrial Psychology (3-0) Cr 3 F *Prereq 440, Stat 402* Critical evaluation of current research, advanced methodologies, and professional problems in industrial psychology

551 Advanced Organizational Psychology (3-0) Cr 3 S *Prereq 440, Stat 402* Examination of organizational behavior research including motivation, job satisfaction organizational climate, organizational effectiveness and the environment Attention rendered to theoretical methodological, and applied issues

560 Advanced Personality Psychology (3-0) Cr 3 F *Prereq 4 courses in psychology, including 360* Analysis of theories of personality, concepts, methods and current research issues

561 Psychopathology and Behavior Deviations. (3-0) Cr 3 S *Prereq 460* Critical review of theoretical perspectives and current research on the development and maintenance of the major forms of maladaptation including schizophrenic, anxiety, affective, drug use personality, psychosexual, reactive, and childhood disorders

562. Personality Assessment. (3-0) Cr 3 S *Prereq 360, 440, Stat 402* Principles, concepts, and methods of personality assessment Though not a practicum course, exposure is given to a variety of objective, projective, and situational tests

580 Advanced Social Psychology I. Psychological Perspectives. (3-0) Cr 3 F SS *Prereq 4 courses in psychology, including 280* Current theories, methods and research in social psychology with an emphasis on individual processes such as attribution, attitude change, attraction, aggression, and helping behavior

581 Advanced Social Psychology II. Psychological Perspectives (3-0) Cr 3 Alt S offered 1982 *Prereq 580* Current theories, methods, and research in social psychology with an emphasis on the individual within a social context Focus on social interaction and interpersonal processes

590. Special Topics. Cr var *Prereq 12 credits in psychology, permission of instructor* Guided reading on special topics or individual research projects
A Counseling
B Industrial-Organizational
C School Psychology
D Individual Differences
E Experimental
F Educational
G Physiological
I Abnormal
J Engineering
K Developmental
L Exceptional Children
M Consumer
N Social
O Personality
P Psychometrics

Courses for Graduate Students, major or minor

601 Historical and Systematic Psychology (3-0) Cr 3 F *Prereq Second year graduate classification* Origins of psychology in philosophical, medical, and related thought Development as an independent discipline in the nineteenth and twentieth centuries Traditional and contemporary theoretical approaches to areas of experimental, academic, and applied psychology

621 Psychological Counseling Introduction to Theory, Process, and Techniques (3-2) Cr 4 F *Prereq 4 courses in psychology including 440 and 460* Combined survey of theoretical issues and approaches with prepracticum development of counseling skills and techniques Didactic coverage of theoretical viewpoints at an introductory level Laboratory based development of relationship skills and interviewing techniques using modeling, role playing, and case studies

623. Vocational Behavior (2-0) Cr 2 F *Prereq 3 courses in psychology* Theories, research, and issues in career development and choice, relationships to job satisfaction and performance, influences of sex roles age, sociocultural factors on career behavior

626. Group Counseling. (2-2) Cr 3 S *Prereq 621* Survey of theoretical approaches, research, techniques issues, and ethics in group counseling Concurrent participation in a group counseling experience

627 **Behavior Therapy** (3-0) Cr 3 F *Prereq 513* Research and theory underlying application of learning principles to techniques of behavior change Introduction to methods of behavior analysis and techniques of behavior therapy

628. **Advanced Counseling Theory** (2-0) Cr 2 S *Prereq Practicum in counseling psychology* In-depth coverage of major theoretical positions, including comparative analysis Coverage and evaluation of research on counseling interventions

633 **Teaching of Psychology.** (1-0) Cr 1 F *Prereq Enrollment in degree program in psychology, completion of at least 1 year of graduate study, permission of instructor* Orientation to teaching of psychology at college level academic issues and problems, instructional and evaluative techniques

642. **Advanced Psychological Assessment.** (2-2) Cr 3 Alt S offered 1983 *Prereq 542 or 562* Analysis of modes of and problems in assessment including theory and research on test bias Consideration of alternatives to standardized tests such as behavioral methods of assessment and use of socio-cultural information in interpretation of test scores

652. **Human Decision Theory.** (3-0) Cr 3 Alt S offered 1982 *Prereq 540, Stat 401* Critical analysis of the human judgment process as represented by normative and descriptive statistical models of decision making Emphasis on issues in human decision making research as policy capturing, boot-strapping, and non-linear inference strategies

691 **Practicum in Psychology.** Cr var *Prereq Permission of instructor* Supervised practice and experience in the following fields of specialization in applied psychology
A Counseling
B Industrial-Organizational
C School Psychology
D Individual Differences
T Teaching *Prereq* 633 S-F grading

692 **Seminar in Psychology** (1-0 to 3-0) Cr 1 to 3 each time taken Offered when demand warrants
A Counseling
B Industrial-Organizational
C School Psychology
D Individual Differences
E Experimental
F Educational
G Physiological
I Abnormal
J Engineering
K Developmental
L Behavioral Consultation
M Professional Issues and Ethics
N Social
O Personality
P Psychometrics

699 **Research**

Religious Studies

Richard J Van Iten, Chair, Advisory Committee

Advisory Committee: J W Elrod*, A M Fink, P W Hollenbach*, G T McJimsey, T J Solomon*, H J Weiss, M B Whiteford, D B Wilson

Religious studies is a cross-disciplinary program in the College of Sciences and Humanities It consists of a core of courses in religious studies and a number of related courses in various departments

Religious studies gives students the opportunity to investigate and reflect on the religions of mankind in an objective, critical, and appreciative manner Though there is emphasis in religious studies on the wide variety of religious phenomena as well as on the various methods in the study of religion, the aim is to help students develop their own integrated understanding of the nature of religion and its role in the life of mankind

Undergraduate Studies

Undergraduate studies in religion, besides having their own intrinsic interest, prepare students for graduate work in theology or religion and teaching about religion in secondary education They serve as supporting studies for graduate work in other humanities and social sciences

The program provides students with the following opportunities to fulfill group requirements, to minor in religious studies, to major in philosophy with a concentration in religious studies, to use religious studies as a component of a distributed studies major, to take religious studies courses that are integrated into another major, to take one or more religious studies courses as electives

Courses are offered in four essential areas of study 1 history and literature of Western religions, 2 history and literature of Eastern religions, 3 religious thought, 4 religion and culture

In addition to the core courses described below, the following courses are an integral part of the religious studies program

Art 280, 281 History of Art
Engl 356 The Bible as Literature
Hist 207 Introduction to East Asian Civilization (to 900 A D)
Phil 310 Ancient and Medieval Philosophy

In addition, such courses as the following may sometimes be relevant to a particular student's program of study Engl 353, 354, 373, 473, 474, Ger or Frnch 101, 102, 201, 202, Hist 201, 207, 401, 402, 403, 405, 406, 408, Phil 230, 312, 320

Graduate Study

The program offers courses for graduate minor work in religious studies as supporting work for other fields

Courses open to graduate students for minor credit only 321, 322, 350, 353, 365, 465, 475, 590

*Religious studies core faculty and student advisers

Courses Primarily for Undergraduate Students

†200. **Introduction to Religious Studies** (3-0) Cr 3, or (3-1) Cr 4 F S SS A systematic presentation of the various areas of study of religion in terms of both subject matter and methodology Fundamental characteristics of religions such as rituals, beliefs, and institutions in relation to the experience and practice of religion in both its western and eastern forms

†210. **Religion in America.** (3-0) Cr 3, or (3-1) Cr 4 F S SS Introductory study of the major beliefs, practices, and institutions of American Judaism, Catholicism, and Protestantism with attention to denominations, civil religion, and new religious movements

†221. **Introduction to the Bible** (3-0) Cr 3, or (3-1) Cr 4 F S SS Modes of interpretation and methods of study Basic themes creation and exodus, prophecy and messiah, sin and salvation The Bible and contemporary religious, ethical and social issues

†240. **Belief and Unbelief.** (3-0) Cr 3, or (3-1) Cr 4 F Investigation of nineteenth- and twentieth-century critics of religion, and religious thinkers who defend religion against its critics

†250. **Introduction to World Religions.** (3-0) Cr 3, or (3-1) Cr 4 F S SS Survey of basic beliefs and practices of major contemporary religions of the world, such as Hinduism, Buddhism, Confucianism, Taoism, Shinto, Christianity, Judaism, and Islam, dealing with basic problems in understanding different types of religion Some attention to problems of interpreting different religions

*321 **The Old Testament.** (3-0) Cr 3, or (3-1) Cr 4 F *Prereq 1 200-level course in religious studies* Literature and religion of ancient Judaism understood within the context of ancient Near Eastern cultures Particular attention given to the development of basic religious and ethical perspectives and their modern relevance

*322. **The New Testament.** (3-0) Cr 3, or (3-1) Cr 4 S SS *Prereq 1 200-level course in religious studies* Literature and religion of early Christianity within the context of contemporary Judaism and Hellenistic culture Particular attention given to the development of basic religious and ethical perspectives and their modern relevance

323. **Science and Religion in Modern European Thought.** (Hist 323) See *History*

340 **Anthropological Perspectives of Religion** (Anthro 340) See *Anthropology*

350 **Philosophy of Religion** (Phil 350) See *Philosophy*

*353 **Ways of Enlightenment: Hinduism and Buddhism** (3-0) Cr 3, or (3-1) Cr 4 F *Prereq 1 200-level course in religious studies* The various Hindu and Buddhist paths to realize enlightenment and freedom Special attention to meditation and yoga and their relationship to altered states of consciousness and Western methods of psychophysical integration

*365 **Western Religious Thought.** (3-0) Cr 3, or (3-1) Cr 4 S *Prereq 1 200-level course in religious studies* An examination of the religious and intellectual upheaval of the Reformation against its Medieval background and its subsequent development Focus on a critical and sympathetic understanding of the major theological, philosophical, and historical forces which form contemporary Judaism, Catholicism, and Protestantism

377 **Sociology of Religion** (Soc 377) See *Sociology*

465. **Seminar: Contemporary Western Religious Thought.** (3-0) Cr 3 S *Prereq 6 credits in religious studies* Selected issues in contemporary religious thought including Protestant, Roman Catholic, Jewish, and secular thinkers

475 **Seminar Issues in the Study of Religion** (3-0) Cr 3 each time taken, maximum of 6 credits Alt F , offered 1981 *Prereq Nine credits in religious studies*

490 **Independent Study** Cr 1-4 each time taken *Prereq 6 credits in religious studies, permission of instructor approval of program chairman* Guided reading and research on special topics selected to meet the needs of advanced students

590 **Special Topics in Religious Studies.** Cr 2 to 4 each time taken *Prereq Permission of instructor, 9 credits in religious studies*
A Western Religions
B Eastern Religions
C Religious Thought
D Religion and Culture

†Optional fourth credit with permission of instructor entails guided research or other complementary study

*Optional fourth credit entails guided research or other complementary study

Sciences and Humanities Cross-Disciplinary Studies

Richard J Van Iten, Associate Dean for Academic Programs and Services

Millard R Kratochvil, Assistant Dean
Ruth W Swenson, Assistant Dean

Cross-disciplinary studies in the College of Sciences and Humanities provide an administrative base for programs of study and courses that cross established departmental lines

Individual Major

Review Board: Judith Lacasa, Chair; C Vondra, L Galyon, R. Groeneveld, H. Schuster

The individual major in the undergraduate curriculum of the College of Sciences and Humanities, leading to either the Bachelor of Arts or the Bachelor of Science degree, is designed to provide program depth in an area of student interest that bridges regular academic majors The major consists of 27 to 40 credits of carefully planned, coherent course work in more than one department; it is not to be used to create a theme to "pull together" courses already taken This major must have a descriptive title that reflects its theme and content. The title will appear in parentheses on the transcript following the words *Individual Major*. There are no predetermined or defined areas of interest except that the individual major will not be used if the student's interests could be well served by any reasonable combination of existing majors, minors, and electives One-half or more of the 27 to 40 credits in the major normally will be in courses in departments of the College of Sciences and Humanities No individual major will be approved if the area of interest properly falls under the purview of another college of the University except by specific permission of the dean of that college At least 20 credits in courses applied to the individual major should be at the 300 level or above

Admission to the program requires approval during the sophomore or junior year and all students are required to earn at least 30 credits after the semester in which the degree program is approved The application and the degree program must be approved by the Individual Major Review Board and the dean before admission to the program The board will determine that sufficient university resources are available and that they are utilized in the program to insure reasonable depth of study in the student's area of interest The other degree requirements are those prescribed for the curriculum in sciences and humanities (see Index, *Sciences and Humanities, Curricula*) The student's application and degree program must be supported by an adviser who is qualified to counsel competently in the student's area of interest The adviser must hold an appointment in the College of Sciences and Humanities unless there is special approval of another university faculty member by the dean Details of this program and procedures for making application are available in the office of the dean, College of Sciences and Humanities

Major in Distributed Studies

For a student whose educational or professional goals can best be met by a broad, flexible curriculum, the Distributed Studies major offers an opportunity to design a program suited to individual academic needs

Programs in Distributed Studies are appropriate preparation for professional studies in human health-related fields (i e , human medicine, medical technology, physical therapy, physician's assistant, cytotechnology, dentistry, nursing, and optometry), law, speech-language pathology and audiology, theology, and veterinary medicine. With careful planning of courses during thee years of preprofessional work at Iowa State University, students in human health-related fields or veterinary medicine may be able to transfer up to 32 appropriate credits earned during the first year in a professional school and meet the requirements for a bachelor's degree from this university Programs in Distributed Studies are also appropriate for preparation for teaching in secondary schools (see *Teacher Education* below)

The basic degree requirements are those established for the curriculum in sciences and humanities (see Index, *Sciences and Humanities, Curricula*) Instead of requiring courses within one discipline for a major, however, the Distributed Studies major requires a minimum of 48 credits in three areas of concentration of at least 15 credits each All courses in these areas must be numbered 200 or above, in addition ⅔ or 32 credits must be numbered 300 or above. (100-level courses in these areas of concentration may be used to meet group requirements, but courses numbered 200 or above may not be used in the four groups) Of the three areas of concentration, only one may be taken in a department outside the College of Sciences and Humanities Courses within various university departments may be combined to make a meaningful area of concentration The areas selected should provide a cohesive whole related to the student's educational goals

The Distributed Studies major must satisfy the following general education requirements

A Students must earn the minimum credits listed in each of the four general education groups of the College of Sciences and Humanities

B Students must earn an additional 12 credits in the groups in departments and subject areas not included in the three areas of concentration Students who have completed 3 years of one foreign language in high school will be exempt from the foreign language requirement and will be required to take 4 instead of 12 additional credits in the groups in departments and subject areas not included in the three areas of concentration

C The following requirements must also be met Credits earned in meeting the following requirements may be used in the general education groups if not used in an area of concentration

1 A student using one of the social sciences as an area of concentration must take a minimum of 6 credits in the mathematical disciplines, including a course in statistics

2 A student using one of the physical sciences as an area of concentration must take a minimum of 6 credits in mathematics, including calculus (when appropriate, statistics may be substituted for calculus)

3 A student having only one area of concentration in the physical sciences must complete one year of course work in a natural science other than the one chosen as an area of concentration A student having an area of concentration in the physical sciences and an area of concentration in the biological sciences would be excused from this requirement

4 A student using one of the biological sciences as an area of concentration must take a minimum of 6 credits in mathematics, including calculus (when appropriate, statistics may be substituted for calculus) and one year of course work in chemistry In addition, course work in physics is recommended

5 A student having only one area of concentration in the humanities must take the equivalent of a two-semester sequence in another of the humanities or in the arts in addition to the sequence required in Group I

A Distributed Studies major must complete one year of college-level study in a foreign language or demonstrate equivalent proficiency Students who have completed 3 years of one foreign language in high school will be exempt from the foreign language requirement and will be required to take 4 instead of 12 additional credits in the groups in departments and subject areas not included in the three areas of concentration

English proficiency will be certified if a student has grades of B or better in English 104 and 105 A student not meeting this requirement must taken an advanced composition course (Engl 204, 302, 305, 414) and obtain a grade of C or better to be certified as proficient in English

Students planning to use the first year of professional school work toward a degree at Iowa State may transfer up to 32 appropriate credits in meeting the requirements for a bachelor's degree in the College of Sciences and Humanities Up to 21 of these credits may be distributed among three appropriate areas of concentration, or 15-18 transferred credits may be used to comprise one area but then not applied in the other two areas The remaining transferred credits may be applied as electives

Students planning to pursue a preprofessional program may designate a Distributed Studies major on entering the University or may enter in the Open Option category and subsequently declare a Distributed Studies major Except for students who are entering traditional preprofessional programs, such as prelaw and premedicine, students already enrolled who desire to change from another major to Distributed Studies are asked to explain in writing how their educational goals can be met with a Distributed Studies major This application letter is to be submitted to the Associate Dean for Academic Programs and Services and approval given before a program can be implemented

Further information may be obtained from the College Office

Cross-Disciplinary Programs

American Indian Studies Program (Minor only)

Program Committee: Chair, G Bataille, J Dow, D Gradwohl, J Hraba, J Pudwill, H Schuster, J Weinkein, J Whitaker

The American Indian Studies Program promotes an awareness of the American Indian in cross-cultural and cross-disciplinary perspectives It includes courses in anthropology, English, history, and sociology and should be especially valuable to students majoring in those areas in the College of Sciences and Humanities The courses are also relevant to students in home economics and education The courses in the American Indian Studies Program provide added background for students whose career interest may include multi-cultural education, human services programming, legal services, or public administration For further information see Index, *American Indian Studies* A list of suggested courses and other information can be obtained from the dean, College of Sciences and Humanities

Biology Program (Major or minor)
Executive Officer: Warren D Dolphin

The Biology Program at Iowa State allows students to undertake broad studies in the life sciences without the specialization inherent in a departmental major Six life science departments (Animal Ecology, Biochemistry and Biophysics, Botany, Genetics, Microbiology, and Zoology) participate in the administration of the Biology Program Instructors and advisers are members of the staff in one of these departments For a description of the program and courses see Index, *Biology*

Environmental Studies Program (Second major only)
Coordinator: Craig B Davis

Students wishing to major in environmental studies in the College of Sciences and Humanities must also complete the requirements for a disciplinary major in that college Environmental Studies may be taken only as a second major

Students pursuing an environmental studies major must complete the full Environmental Studies Program and the following cognate course work

I Chemistry 163, 163L, Physics 111, Biology 110, and Geology 100

II One of the following courses Chemistry 231, Physics 112, Biology 312, Microbiology 300, or Meteorology 301

III One course in each of the following disciplines statistics, economics, sociology or anthropology, and political science Courses selected must be approved by the coordinator of environmental studies

IV One additional course in one of the following disciplines economics, political science, sociology, or anthropology This course must also be approved by the coordinator of environmental studies

International Studies Program (Second major only)
Program Committee: K Friederich, Chair, J Anderson, J Beard, H Chang, J Courteau, G Dorfman, S Huang, K Kruempel, W Osborn, J Scott, D Warren, H Van de Wetering

See Index, *International Studies Program*

Linguistics Program (Minor only)
Program Committee: Clyde Thogmartin, Chair, S Gonzo, M Lee, D Lempers, M Mason, W R Underhill, M Warren

A minor in linguistics may be elected by students in the curriculum in sciences and humanities This minor enables students interested in the study of human language to design an integrated multidisciplinary program from courses offered by the departments of Child Development, English, Foreign Languages and Literatures, Philosophy, Psychology, Sociology and Anthropology, and Speech For further information, see Index, *Linguistics*.

Religious Studies Program (Minor only)
Program Committee: Richard J Van Iten, Chair, J W Elrod, A M Fink, P W Hollenbach, G T McJimsey, T J Solomon, H J Weiss, M B Whiteford, D B Wilson.

Religious studies gives students opportunity to investigate and reflect on the religions of mankind in an objective, critical, and appreciative manner Though there is emphasis in religious studies on the wide variety of religious phenomena as well as on the various methods in the study of religion, the aim is to help students to develop their own integrated understanding of the nature of religion and its role in the life of mankind For further information see Index, *Religious Studies*

Women's Studies Program (Minor only)
Program Committee: Linda R Galyon, Chair, R W Bernard, G M Ebert, B A Glatz, K K Hickok, M Y Lee, J S Rasmussen, two student members

The Women's Studies Program is designed to provide an opportunity for students to examine the contributions, experiences and roles of women within the context of biology, family, religion, educational, political, social, cultural and economic systems It includes "core" courses in English, economics, history, physical education, political science, psychology, sociology, and additional courses in other areas Students wishing to elect a minor in women's studies should contact the chair of the Women's Studies Program Committee A list of suggested courses and other information is distributed to all women's studies minors and can also be obtained from the dean, College of Sciences and Humanities, or the chairperson of the Women's Studies Program See Index, *Women's Studies*

The Honors Program in Sciences and Humanities
Program Committee. Paul E Nelson, Chair, J Bower, S Consigny, G S Cox A Steiner, E Yeung, two student members

The Honors Program is intended for ambitious students who have a 3 35 grade point average or higher An honors student who completes his or her honors program will have that accomplishment recorded on the official transcript and on the diploma Honors students are expected to take two honors courses and two honors seminars, to complete a program consistent with the honors guidelines, and to complete an honors project For further information call or visit the Honors Program Office at Osborn Cottage

Teacher Education Program
Program Committee: Clair Keller, Chair, T Andre, W Chatfield, L Hodges, Q Johnson, G Knaphus, R Lambert, two student members

Students in the College of Sciences and Humanities may be recommended for the Iowa Professional Certificate for full-time teaching in secondary schools where the subject to be taught is biology, chemistry, earth sciences, English, foreign languages, general science, journalism, mathematics, music, physical science, physics, social studies, or speech Students wishing teaching certification in one of these areas need not have that major, although it is usually convenient to do so Candidates for admission to teacher education must make formal application to the Teacher Education Committee of the College of Sciences and Humanities at least three semesters before the one in which they plan to enroll in student teaching A 2 3 grade-point average is required for admission to the Teacher Education Program, and this minimum average must be maintained through graduation Students in the Teacher Education Program in Sciences and Humanities must earn at least 6 semester credits with a grade of C or better in courses used to meet their department's English proficiency requirement Specific courses taken to be used for certification may not be taken Pass/Not Pass The specific course work requirements for certification and for a degree with a major in the College of Sciences and Humanities are set forth below

Group Requirements
In addition to meeting Sciences and Humanities group requirements, the following must be included

A 1 credit in health dance physical education or safety

B Psych 230

C A course in American history or American government

D Sp 211 or 212

The Professional Education Requirement

Foundations of American Education — Sec Ed 204
Instructional Media — Sec Ed 301
Educational Psychology — Psych 333
Principles and Issues of Secondary Education — Sec Ed 426
Multicultural Awareness — Sec Ed 406*

*Plus 2 additional approved courses to fulfill human relations requirement from the following list: C D 542; Anthr 218, 322, 332, 333; Pol S 385; Psych 346; F E 385; El Ed 450; Hist 275, 386; Soc 300, 327, 529; Engl 345, 346, 347, 348, 349, 514; Co Ed 538. Additional courses may be added.

Student Teaching and Special Methods

Biology — S-H 417D 2nd 8 wks, F,S, 486
Chemistry — S-H 417B 2nd 8 wks, F,S, 486.
Earth sciences — S-H 417J 2nd 8 wks, F,S, 486
English — Engl 494, S-H 417E 1st and 2nd 8 wks, F,S
Foreign languages — F Lng 476, S-H 417G 2nd 8 wks F, 1st 8 wks S
General science — S-H 417B 2nd 8 wks, F,S, 486
Journalism — Jl MC 480, S-H 417I 1st & 2nd 8 wks F, 1st 8 wks S
Mathematics — Math 497, S-H 417C 2nd 8 wks F
Music — Music 464 or 465, 466, S-H 417K and/or 417L 2 8-wk sessions, S *
Physics — S-H 417B 2nd 8 wks, F,S, 486
Social studies — S-H 417A 2nd 8 wks, F,S, 487
Speech — Sp 495, S-H 417F 1st and 2nd 8 wks, F,S

*Students seeking K-12 music certification student-teach the first 12 weeks of spring semester.

Subject Matter Courses
For full-time teaching in secondary schools an approved subject matter concentration of at least 30 credits is required Additional certification in some areas is possible by earning 20 credits in each of those respective areas
All the minimal number of subject matter credits in an area of specialization in the College of Sciences and Humanities should carry a grade of C or better Required credits in the area of specialization which carry a grade of F or D must be repeated with a grade of at least C or, with the approval of the area supervisor, may be supplemented with an equal number of credits that carry a grade of at least C and are in the same area and beyond the minimal requirement Exceptions may be approved by

the area supervisor if the grade point in the area of specialization is at least 2.5.

Biology
Coordinator: George Knaphus

Students seeking approval to teach biology must eam credits in the following courses
B B 301; or 404 and 405
Biol 110, 110L, 303, 312.
Bot 207; 202 or 306; 310 or 404 or 405
Gen 320 or 330
Micro 300
Zool 206, 206L, 355
One course from A Ecl 320, 320L, Ent 370, Zool 434

Chemistry
Coordinator: Wilbert Hutton

Students seeking approval to teach chemistry must eam credits in the following courses
General and analytical chemistry 177, 177L, 210; or 163, 163L, 164, 211
Organic chemistry 331, 332, 333A, 334A
Inorganic chemistry 301
Physical chemistry 321, 321L
Phys 221, 222.

Students seeking approval to teach chemistry as an additional area must eam credits in the following courses.
General and analytical chemistry 177, 177L, 210; or 163, 163L, 164, 211.
Organic chemistry 331, 332, 333A
Inorganic chemistry 301 (permission to take 301 without 321 prerequisite) or
Physical Chemistry 321 or 324
Phys 221

Earth Sciences
Coordinator: Fredenck DeLuca

Students seeking approval to teach earth sciences must eam credits in the following courses

Geol 100 or 210, 211, 241, 365, 302B
Mteor 206.
Astro 120, 150
Geog 100

Students seeking approval to teach earth sciences as an additional area must eam credits in the following courses.
Geol 100 or 210, 211
Mteor 206.
Astro 120.
Geog 100
Courses 300 or above — 3 credits.

English
Coordinator: Richard J. Zbaracki

Students seeking approval to teach English must eam credits in the following courses:
Core requirements. Engl 210; 496, 204 or 304 or 305, 219; 220 or 419 or 420
Studies in literary history 6 credits from. Engl 360, 361, 362, 363; and 6 credits from 373, 374, 375, 376, 377, 378
Studies in genres, authors, or criticism 3 credits from: Engl 366, 370, 391, 392, 449, 473, 474, 489
Composition and linguistics: 6 credits from: Engl 204, 304, 305, 306, 404, 405, 220, 419, 420, 495; Soc 405; Psych 413; Sp 305
Reading: Engl 395.

Foreign Languages and Literatures
Coordinator: Walter Chatfield

Students seeking approval to teach a foreign language must eam credits in that one foreign language, in the courses indicated below, at least 34 credits must be earned Full certification requires Foreign Language 476

French 301, 302, 321, 322, 401, 402

German 301, 302, 401, 402, and 6 additional credits from any 300- or 400-level courses

Spanish 301, 302, 321, 322, 401, 402

Russian 301, 302, 321, 322, 401, 402

Prior to receiving approval in any of the modern languages the candidate must demonstrate adequate speaking proficiency in the language to be taught, as stated by departmental policy

Students seeking approval to teach one of the above foreign languages as an additional area must eam 22 credits in that language, 6 of these credits must be in composition and conversation at the 300 or 400 level

In addition to the above languages, students may seek approval to teach Latin, Greek and Portuguese as an additional area by taking 22 credits in that language, 6 of these credits must be 300 level courses or above Latin also requires History 403 Greek also requires History 402

General Science
Coordinators: Frederick DeLuca, James Dixon, Wilbert Hutton, George Knaphus

Students seeking approval to teach general science must earn credits in the following courses
Biol 110, 110L
Bot 207
Chem 163, 163L, 231, 232
Geol 100 or 210
Phys 111, 112, or 221, 222
Zool 206, 206L

At least 6 credits from courses numbered 300 or above in astronomy and astrophysics, biochemistry and biophysics, biology, botany, chemistry, genetics, geology, meteorology, microbiology, physics, and zoology

Journalism and Mass Communication
Coordinator: Richard Kielbowicz

Students seeking approval to teach journalism must eam credits in the following courses
Jl MC 101, 201, 202, 203, 312, 370, 430, 480, 491, 499, one course from 317, 319, 325, 342, 345, 352, 354, 360, one course chosen from 410, 425, 431, 438, 440, 450, 462, 464

Students seeking approval to teach journalism as an additional area must eam credits in the following courses:
Jl MC 101, 201, 202, 203, 312, 370, 480, and at least one additional 300- or 400-level course

Mathematics
Coordinator: William Rudolph

Students seeking approval to teach mathematics must eam credits in the following courses.
Math 165, 166 (or 175, 176), 301, 270 or 307 or 302, 435, 436, 489, Com S 111 or 175, Math 304 or Stat 341, plus an additional 6 credits in courses numbered 200 or above in mathematics, computer science (except Com S 200 or 201), or statistics (except Stat 227 or 228)

Students seeking approval to teach mathematics as an additional area must eam credits in the following courses:
Math 165, 166 (or 175, 176); 301; 270 or 307 or 302; 435; 489; Com S 111; Math 304 or Stat 341

Music
Coordinator: David Woods

Students seeking approval to teach music (kindergarten through grade 12) must earn credits in the following courses
C D 226

Music 119, 120, 219, 230, 231, 319, 330, 331, 361, 362, 419, 3 credits of advanced music history, and 3 credits of advanced music theory

Music 360, 465 and 466 are required for students planning to teach vocal music

Music 350, 351, 352, 353, 354, 355, 356, 464 466 are required for students planning to teach instrumental music

A student seeking approval to teach only on the elementary or secondary level should confer with the Department of Music concerning modification in this program

Physical Sciences
Coordinators: Frederick DeLuca, James Dixon Wilbert Hutton

Students seeking approval to teach physical sciences must eam credits in the following courses
Astro 120, 150, or 344, 345
Chem 163, 163L, 231, 232
Geol 100 or 210
Mteor 206
Phys 111, 112; or 221, 222
Three credits from courses numbered 300 and above in astronomy and astrophysics, chemistry, meteorology, physics, and geology

Students seeking approval to teach physical sciences as an additional area must eam credits in the following courses
Astro — 3 credits from 120, 150
Phys 111, 112, or 221, 222
Chem 163, 163L
Mteor 206
Geol 100 or 210

Physics
Coordinator: James E Dixon

Students seeking approval to teach physics must eam credits in the following courses
Astro 344
Phys 221, 221L, 222, 222L, 311T, 399 (2 cr), 321, 321L, 322, 322L, and 3 additional credits from Phys 304, 361, 364

Students seeking approval to teach physics as an additional area must eam credits in the following courses.
Phys 221, 221L, 222, 222L, 311T, 399 (2 cr) and 3 credits from 321 or Astro 344

Social Studies
Coordinator: Clair Keller

Students seeking approval in all areas of the social studies must complete one of the following options

Option I 54 semester credits distributed as follows American history 6, world history 9, economics 12, sociology 12, political science 12, geography 3

Option II 54 semester credits distnbuted as follows American history 12, world history 12, economics 9, sociology 9, political science 9, geography 3

Students seeking approval to teach in specific areas of the social studies must complete 12 semester credits in each of three areas and take

one course in each of the remaining three areas, total 45 semester credits

Economics
Econ 201, 304, 306, 312, 401, 402, 404, 405, 406, 410, 445, 446, 455, 461, 465

Sociology
Soc 130 or 134 and credits as needed from 201, 235 300*, 302, 305, 310, 327*, 331, 340, 350, 377 380, 381, 382, 410, 411, 415, 420, 425, 461 473, 485

American Government
Credits as needed from Pol S 215, 241, 251, 305 306, 310, 311, 320, 358, 360, 361, 371, 385* 405, 410, 411, 421, 433, 453, 464, 471

Geography
Geog 100, 202, 301, 324, 325, 326, 328, 490, 495

United States History
Credits as needed with at least one course from each group
Group 1 221, 351, 381, 450, 451, 452, 454, 455, 462, 465, 467
Group 2 222, 275*, 352, 370, 382, 386*, 457, 458, 459, 463, 464, 468

World History
Credits as needed with at least one course from each group
Group 1 201, 265, 325, 401, 402, 403, 405, 406, 407, 408, 427, 428
Group 2 202, 326, 410, 411, 412, 414, 416, 417, 419, 421, 422, 424, 426, 430, 431
Group 3 207, 208, 211, 336, 337, 340, 341, 436 441

Students who have approval in other subjects and who wish additional approval to teach a specific area of the social studies must take S-H 487 and complete 20 semester credits in the area of approval or complete 12 semester credits in an approval area plus 15 semester credits with at least one course from each of the other social studies areas

Speech
Coordinator: Frances S Langford

Students seeking approval to teach speech must earn credits in the following courses
Sp 215, 255, 305, 311, 322, 332, 358, 360, 375, 412 455, 495

*Courses acceptable to fulfill human relations requirement

Courses Primarily for Undergraduate Students

100 Orientation and Introduction to Career Planning Materials for Open Option Students (2-0) Cr 0 5 F S Last 12 weeks Orientation to university resources, guided analysis of interests and abilities, facilitation of decision-making skills and goal setting, visits with faculty and professionals in fields of potential career interests to individual students Offered on a satisfactory-fail basis only

104. Career Development for Open Option Students (2-0) Cr 2 S An in-depth exploration of career development theory and careers that correspond to the values, interests, and abilities of the student Taught in small sections to provide an opportunity for intensive self-analysis in relation to personal career development

105. Orientation to Medical Technology. (1-0) Cr 0 5 F First 8 weeks *Prereq Sophomore classification* Nature and responsibilities of the profession, preprofessional education, internship, expertise, certification, employment opportunities Offered on a satisfactory-fail basis only

111 Elementary Physical Science I. (1-4) Cr 3 F For students in elementary education and child development Topics are selected from astronomy, weather, mechanics, light, sound, geology

112. Elementary Physical Science II. (1-6) Cr 3 S *Prereq 111* For students in elementary education and child development Topics are selected from chemistry, electricity, magnetism, heat, geology, astronomy

121 Pre-veterinary Medicine Orientation. (1-0) R F First 5 weeks Preparation for the study of pre-veterinary medicine study skills, curriculum requirements, university policies, procedures, and resources. Vet Med admission policy Required of all transfer and freshman pre-vet students enrolled in the College of Sciences and Humanities

122. Career Orientation for Pre-vet Students (1-0) Cr 0 5 S First 8 weeks Presentations by veterinarians in practice, research, and special fields on career opportunities within veterinary medicine and in related areas, examination of majors through experience in analyzing individual interests, abilities, and needs Offered on a satisfactory-fail basis only

230. Cross-Cultural Explorations Introduction to Third-World Cultures. (3-0) Cr 3 F S Third-World belief systems, family patterns, historic settings, linguistic expression, artistic tastes, and political environment are considered as formative in today's changing world Presented by a cross-disciplinary faculty and a staff of international resource personnel

241H. The Individual, Nature and Society: The Ancient Period. (3-0) Cr 3 F Intended primarily for students in the University Honors Program Using the literary, philosophical, historical, political, and artistic works of a selected time period, this course will examine how the individual viewed himself in relation to society and the physical world Selected time period may vary according to the instructor More specific information concerning course content may be obtained at the Honors Office

242H The Individual, Nature and Society: The Modern Era Cr 3 S Intended primarily for students in the University Honors Program Using the literary, philosophical, historical, political and artistic works of a selected time period, this course will examine how the individual viewed himself in relation to society and the physical world Selected time period may vary according to the instructor More specific information concerning course content may be obtained at the Honors Office

*290. Special Problems Cr 1-3 each time taken *Prereq Freshman or sophomore classification, permission of instructor*

417 Student Teaching (Sec Ed 417) Cr 6-8 each time taken F S * *Prereq Engl 494, or F Lng 476, or Jl MC 480, or Math 497, or Music 466, or S-H 486 or 487 or Sp 495, admission to teacher education, approval of coordinator during semester before student teaching* Observation, evaluation of instruction, lesson planning, and teaching in the sciences and humanities
A Social Studies
B Physical Sciences
C Mathematics
D Biological Sciences
E English and Literature
F Speech
G Foreign Languages and Literatures
I Journalism
J Earth Sciences
K Music-Secondary
L Music-Elementary

480 Special Preparation in Subject Matter for Elementary and Secondary Education Teachers (Sec Ed 480) Cr var Maximum of 9 credits in each area listed below
A Social Studies
B Physical Sciences
C Mathematics
D Biological Sciences
E English and Literature
F Speech
G Foreign Languages and Literatures
I Journalism
J Earth Sciences
K Music

486 Methods of Teaching Science (Sec Ed 486) (6-0) Cr 3 F S First 8 weeks *Prereq Admission to teacher education, 15 credits in subject-matter field* Topics include preparation for instruction, spectrum of teaching methods, motivational techniques, safety, discipline, conducting field trips, and application of teaching and learning theory Field trips

487 Methods of Teaching Social Studies (Sec Ed 487) (2-0) Cr 2 or (2-3) Cr 3 First 8 weeks, F S *Prereq Admission to teacher education and 15 credits in subject-matter field* Topics include objectives, questioning strategies, classroom activities, differentiating instruction, multi-cultural and non-sexist education, and evaluation Students taking 417A enroll for 3 credits, others optional

*490 Independent Study. Cr 1-3 each time taken *Prereq Junior or senior classification, permission of instructor*

*These course numbers may be used only with the permission of the Dean of the College of Sciences and Humanities and concurrence by the Sciences and Humanities Curriculum Committee

Secondary Education

Harold E Dilts, Head of Department

Professors: Bath, Brown, Burkhalter, Charles, Crawford, Dilts, Fanslow, Glass, Hoerner, Hughes, Hunter, Kahler, Keith, Keller, Knaphus, Kniker, Rasmussen, Schloerke, Schneider, L G Smith, Volker, Williams, Zbaracki

Associate Professors: Andre, Carter, Dake, DeLuca, Fowler, Glenger, Irwin, Jarchow, Phye, Rudolph, Schultz, Simonson, F M Smith, Tanner, Williams, Wood, Woods

Assistant Professors: Amos, Chatfield, Christensen, Ebert, Gilbert, Hausafus, V Jones, Kent, Kroll, Langford, Miller, Payne, Ralston, Ransom, Torrie

Instructors: Townsend, Underwood

Undergraduate Study

Students seeking recommendations for a certificate to teach in the secondary schools must be admitted to the teacher education program and pursue a program which includes the following professional sequence courses Psych 333, Sec Ed 204, 301, 406, 426, special methods, and student teaching in the area of specialization

All students who are recommended by Iowa State University for teacher certification must meet the requirement of the teacher education program and be recommended by the College of Education Each student will be enrolled in the department in which he or she plans to major, and must meet the graduation requirements of that department and the college in which it is located For specific requirements for each area of specialization, see *College of Education, Curricula* and curricula for the college in which the chosen degree major is sought

Graduate Study

Graduate programs with a specialization in curriculum and/or media are administered through the Department of Professional Studies in Education

Courses Primarily for Undergraduate Students

190. Independent Study. Cr 1-4

204. Foundations of American Education (El Ed 204) (3-0) Cr 3 F S.SS Goals of schooling, including the roles of teachers today; historical development of schools, educational reforms and alternative forms, and current philosophical issues. Human relations aspects of teaching and discussions about teaching as a career

280. Teacher Aide (El Ed 280) (0-2) Cr 1 or 2 F S. *Prereq: Credit or classification in 204* Field experience in classrooms of the area. Work with students under supervision of a professional educator Offered on a satisfactory-fail basis only

290. Independent Study. Credits 1 to 3 Offered on a satisfactory-fail basis only

301. Instructional Media (El Ed 301) Cr 1 F S SS *Prereq: 204, credit or classification in Psych 333, eligibility for and formal application submitted to the teacher education program, junior classification* Design, production, presentation, and evaluation of educational media for teaching in specific subject areas. Analysis of commercially and locally produced software including multi-cultural and human relations materials Planning, developing objectives, and techniques of teaching with media

406. Multicultural Awareness and Nonsexism in the Classroom (El Ed 406) (2-1) Cr 2 F S SS *Prereq 301* Awareness and nature of cultural pluralism, need for multicultural education, educational principles and societal-cultural groups, their perceptions, contributions, and needs, problems and issues including prejudice, discrimination, racism, sexism in school, classroom, instructional materials, curriculum incorporation, analysis and development of instructional materials, multicultural interaction, design and execution of teaching strategies

426. Principles of Secondary Education. (3 or 4-0) Cr 3 or 4 *Prereq: 301* F S.SS The curriculum, classroom management, organization of schools, career planning, student evaluation, legal aspects of education, career education, human relations, support services, professionalism, and individualizing instruction A planned field experience is a professional growth activity included in the course Students enrolling for four credits must complete an extended field experience

433. Teaching of High School Psychology. (Psych 433) See Psychology

476. Methods of Teaching Foreign Languages. (F L 476) See Foreign Languages and Literatures

486. Methods of Teaching Science. (S-H 486) See Sciences and Humanities Cross-Disciplinary Studies

487. Methods of Teaching Social Studies. (S-H 487) See Sciences and Humanities Cross-Disciplinary Studies

490. Independent Study Cr 1 to 3 *Prereq Grade-point average of 2 5 or more for preceding two quarters*

A Music Education (Music 490A) See Music
B Vocational and Educational Guidance
C Curriculum Construction
D Principles of Education
E Methods of Teaching
H Honors Program
I Foundations of Educational Statistics
S Foundations of Education

494. English in the Secondary Schools. (Engl 494) See English

495. The Teaching of Speech. (Sp 495) See Speech

497. Teaching of Secondary School Mathematics. (Math 497) See Mathematics

Sociology and Anthropology

Gerald E Klonglan, Chair of Department

Professors: Bohlen, Bultena, Cohen, Dean, Goudy, Gradwohl, A H Johnson, Keith, Klonglan, Mulford, R C Powers, Schafer, Tait, Warren, Whiteford

Emeritus Professors: Beal, Lunden

Associate Professors: Bower, Bruton, Chang, Hoiberg, Hraba, Miller, Richards, Ryan, Schuster, Simons, Wilcox, Woodman

Assistant Professors: Aigner, Harrod, Hoyt, Huang, R. A. Johnson, Korsching, Lee, Lorenz, Nowak, Rombough, Winkelpleck

Undergraduate Study

The department offers work for the degrees Bachelor of Arts and Bachelor of Science with majors in sociology and anthropology, and work for the degree Bachelor of Science in public service and administration in agriculture. Programs of study in sociology offered in both the College of Agriculture and the College of Sciences and Humanities are outlined in this section Programs in anthropology are described under *Anthropology*. For the undergraduate curriculum in sciences and humanities, with majors in sociology and anthropology, leading to the degrees of Bachelor of Arts and Bachelor of Science, see *Sciences and Humanities, Curriculum* For the undergraduate curriculum in agriculture, with major in public service and administration in agriculture, leading to the degree Bachelor of Science, see *Agriculture, Curriculum in Public Service and Administration in Agriculture*

College of Sciences and Humanities — Sociology

A major in sociology can serve as a liberal arts education, as preparation for various positions in social service and related occupations in business and industry, as background for professional education in such areas as social work, law, and theology, or as a basis for graduate professional training as a sociologist in academic, government, business, and industrial settings

A program of study that meets the needs and interests of the student and department requirements will be developed in consultation with the major adviser Programs of study will include 115, 134, 201, 302, 305, 401, and Stat 101 Programs leading to a Bachelor of Arts degree will emphasize additional course work in groups I, II and IV of the general education requirements Programs leading to a Bachelor of Science degree will emphasize additional course work in groups III and IV of the general education requirements Some of the possible fields of concentration are criminal justice system, community (urban and rural sociology), family sociology, industrial sociology, social science teaching, research methods and statistics, social change and sociology of development, complex organizations, human population and ecology, social psychology, sociological theory, and social work

In consultation with their advisers, students may gain work experience and develop their skills in their field of concentration through the field observation and practice options of 454, 460, and 469

College of Sciences and Humanities — Social Work Program

The Department of Sociology and Anthropology offers a program of concentration in social work Social workers assist individuals, families, groups, and communities to satisfy their material, social and psychological needs As planned-change agents, social workers also contribute to the development of social welfare policy This program prepares students for professional employment in public and private programs, and for admission to graduate school Graduates may go directly into the second year of graduate study in social work As sociology majors, students in the social work program take both the required courses for sociology majors and the required social work courses. When combined with electives, these courses present the student with knowledge of human behavior and the social environment, the generic skills of planned change for individuals families, groups and communities, and the ability to initiate and develop service delivery systems and social welfare policy

Students must take 261 and make formal application before being admitted to the program Usually during their senior year and following the social work courses or simultaneous with some of the courses, students are placed in a human service agency under a field instructor. This program is accredited by the Council on Social Work Education Upon graduation students may join the professional organization, the National Association of Social Work. Student membership is available for juniors and seniors.

Programs of study will include 115, 134, 201 302, 305, 401, Stat 101, and may lead to a Bachelor of Arts or a Bachelor of Science degree In addition, programs of study for social work students will include 261, 300, 461, 462, 463, 464, and 469 Other courses such as 264 310, 327, and 340 are strongly recommended Social work students are advised to consult with the social work faculty and their major adviser in designing a program of study that will satisfy their particular interests.

College of Agriculture — Public Service and Administration in Agriculture

The curriculum in public service and administration in agriculture is designed for students who desire an interdisciplinary education to pursue a career with agriculturally related governmental and private agencies, or with businesses and industries that are concerned with public services in agriculture Students will explore the planning and implementing of agriculturally related programs in communities (town, city, or county), multicounty areas, states, regions, and at the federal level

The curriculum has a broad base of general education subjects including credits in communications, mathematics, physical and biological sciences, social sciences, and humanities The technical subjects represent a combination of sociology, economics, government, and technical agriculture, with emphases on social and economic change, history of public services, complex organizations, interagency relationships, community leadership, community action, adoption and diffusion, group dynamics, land utilization, and political and legal behavior as they relate to agriculture and rural areas

Graduate Study — Sociology

The department offers work for the degrees Master of Science and Doctor of Philosophy with majors in sociology and rural sociology and minor work for students majoring in other departments For M.S and Ph D departmental requirements, see "Program of Graduate Study for Degrees in Sociology and Rural Sociology," available from the department office Some of the fields of possible concentration are community studies and development, complex organizations, crime and deviance, environmental sociology, family, gerontology, methodology, population/ecology, rural sociology, social change and development, social organization, social psychology, and sociological theory Within the sociology major students may specialize in anthropology at the master's level. The sociology department does not offer a nonthesis master's program

Although the department stipulates no language requirement for either the degree Master of

Science or the degree Doctor of Philosophy, specifying competence in one or more languages may be desirable in some instances

The department participates in the interdepartmental programs of Gerontology, Industrial Relations, Technology and Social Change, Transportation Planning, and Water Resources (See Index)

Courses open to graduate students for minor credit only 400, 401, 405, 410, 411, 415, 420, 425, 440, 461, 462, 463, 464, 473, 476, 485

College of Sciences and Humanities — Anthropology

For course descriptions and programs in anthropology, see *Anthropology*

Sociology

Courses Primarily for Undergraduate Students

*110 Onentation to Public Service and Administration in Agriculture. (1-0) Cr R F Survey of public service and administration in agriculture

115 Orientation to Sociology (1-0) Cr I F S Orientation to sociology and the department Occupation tracks and career options open to sociology majors, introduction to career planning Recommended during sophomore year Offered on satisfactory/fail basis only

†*130 Rural Institutions and Organizations (3-0) Cr 3 F S An introductory analysis of sociological concepts and theories as they relate to rural institutions and organizations Emphasis on the static structure and function of these institutions and organizations and on their dynamic adaptation to changing societal, environmental, and economic conditions General sociological principles and perspectives

†134 Introduction to Sociology (3-0) Cr 3 F S SS Basic concepts and perspectives in the scientific study of human social behavior Emphasis on practical application to understanding inequality, institutional structures, change, and problems in modern societies

201 Analysis of the Social Order (3-0) Cr 3 F S SS *Prereq 130 or 134* Principles of scientific inquiry in relation to processes and problems of social organization

219 Courtship and Marriage. (3-0) Cr 3 F S SS *Prereq 130 or 134* Person-centered analysis of courtship and marriage relationships, contributions of the various fields of knowledge to the understanding of courtship and marital adjustment

235 Social Problems (3-0) Cr 3 S *Prereq 130 or 134* Nature and meaning of social problems, incidence and characteristics of selected social problems of major public interest, analysis of proposed solutions

261 Introduction to Social Work and Social Welfare (2-0) Cr 2 F S *Prereq 130 or 134, sophomore classification* General aspects of social work and social welfare evolution of social work profession, philosophy, values and strategies of intervention specific aspects of target population and client systems in Iowa, e g , minority groups the poor, emotionally disturbed and the aged

264 Small Group Dynamics (3-0) Cr 3 F S *Prereq 130 or 134* An introduction to the processes of interpersonal behavior in small groups Emphasis on work groups, friendship groups, experimental groups and groups in total institutions Includes student participation in small group processes

300 Ethnic and Race Relations (3-0) Cr 3 F S SS *Prereq 130 or 134* Analysis of ethnic and race relations, particularly in America, emphasis on the sociology and psychology of race and ethnic relations

301 Nuclear Power: Technical Concerns and Social Issues. (Nuc E 301) (2-0) Cr 2 F The relationship between nuclear energy and society from both a technical viewpoint, including energy conversion methods and fuel cycles, and a social viewpoint, including political and social costs of energy policies and weapons proliferation

302 Research Methods in Sociology (2-2) Cr 3 F S *Prereq 130 or 134, and 201* Introduction to research in sociology Principles of scientific inquiries and basic understanding of research methods

305. Social Psychology: A Sociological Perspective. (3-0) Cr 3 F S SS *Prereq 130 or 134* Examination of human behavior in a social environment with emphasis on development of the self, interpersonal relations, attitudes, and small groups

*310 Community (3-0) Cr 3 F S SS *Prereq 130 or 134* Comparative analysis of the institutional structure of rural, urban, and suburban communities, community as an ecological and social system, power relationships, analysis of planned and unplanned processes of social change

327 Sex Roles in Modern Society (W S 327) (3-0) Cr 3 F S SS *Prereq 130 or 134* Examination of changes in sex role learning, femininity-masculinity, sex-role conflicts, and sociocultural value patterns

331 Social Inequality (3-0) Cr 3 F S *Prereq 130 or 134* Social status and social class, stratification of American society, dimensions of poverty

340 Deviant and Criminal Behavior. (3-0) Cr 3 S SS *Prereq 130 or 134* The meaning, identification, and causes of social deviance, role of social institutions in correction, control, and prevention of social deviance

345 Population Studies. (3-0) Cr 3 F *Prereq 130 or 134* Study of population dynamics, change in population size, composition, distribution, fertility, morality, and migration, socioeconomic, psychological, and cultural determinants, and consequences of population change

350 Human Ecology. (3-0) Cr 3 S *Prereq 130 or 134* Basic theories, and methods of human ecology, sociocultural elements as determinants of people's relationship to environment, study of social organization

377 Sociology of Religion (Relig 377) (3-0) Cr 3 S *Prereq 130 or 134* The social institution of religion relative to personality, social status, economics, political institutions, family, religion, and social change

380 Sociology of Work. (3-0) Cr 3 F S *Prereq 130 or 134* Sociological and holistic analyses of work behavior, meaning, and work settings Case-study analyses

381 Social Psychology of Small Groups (Psych 381) (3-0) Cr 3 S *Prereq Soc 305 or Psych 280* A survey of small group research and theory from a social psychological perspective Major theories of interpersonal behavior such as exchange theory equity theory, and status consistency theory, and major areas of research such as leadership, power, conformity, bargaining, status, norms, and roles

*382 Environmental Sociology (3-0) Cr 3 F *Prereq 130 or 134* Environmental quantity and quality as social problems, value orientations toward nature, environmental quality movement, institutional patterns affecting use of natural resources, resource management issues

*383 Sociology of Leisure and Recreation (3-0) Cr 3 S *Prereq 130 or 134* Social significance of leisure human values in leisure time pursuits, evaluation of current uses of leisure, social institutional structure and functional systems of society related to leisure behavior

400 History of Sociological Thought. (3-0) Cr 3 Alt F offered 1981 *Prereq 130 or 134* Surveys the source and content of sociological thinking from ancient civilizations to roughly 1900

401. Contemporary Sociological Theories. (3-0) Cr 3 F S *Prereq 130 or 134* Contemporary sociological theories and applied uses for researching, understanding, and analyzing the social world

405 Sociology of Language (Sociolinguistics) (3-0) Cr 3 Alt F offered 1982 *Prereq 130 or 134, Anthr 221 or Engl 219* Analysis of language structure and linguistic behavior in various social contexts, language and technological change, language planning, linguistic behavior relative to social stratification, ethnic and racial groups, and reference groups, language in socialization and assimilation, language problems in social change

410 Urban Sociology (3-0) Cr 3 or (3-1) Cr 4 S *Prereq 130 or 134* Growth, structure, and functions of the city, urban-social relations Optional fourth credit entails guided research or other complementary study

*411 Societal Change and Development. (3-0) Cr 3 F *Prereq 130 or 134* Contemporary changes in rural and urban society with analysis of social institutions, social organizations, and social values Theories of social change Adequacy of existing social structures to meet needs of people Alternative development structures and strategies to meet changing needs

412. The Professional and Career Development. (1-0) Cr 1 F *Prereq 115, 201, 302, 305, and senior classification* Role transition from student to professional Employment procedures including self-assessment, resumes and interviews, short-term and long-term goals, strategies for career placement and development Enrollment preferred in first semester as senior Offered on a satisfactory-fail basis only

*415. Adoption and Diffusion of Innovations. (3-0) Cr 3 S *Prereq 130 or 134* Processes of adoption and diffusion of innovations Factors related to differential rates of adoption of new technology, such as sources of information, attitudes, values, knowledge, and personal and social characteristics

*420. Analysis of Complex Organizations. (3-0) Cr 3 F SS *Prereq 130 or 134* Organizations as bureaucratic social systems Emphasis on creation of organizations and agencies and their internal operations, linkages among agencies and to the general public

425 Mass Movements in Modern Societies (3-0) Cr 3 F *Prereq 130 or 134* Comparative analysis of individual, cultural, and social factors involved in collective behavior (crowds, mobs, riots), natural disasters, and social movements Theoretical approaches such as symbolic interactionism, field, and conflict utilized to interpret perceptions, values, norms, goals, organization, and social effects of the above

440. Juvenile Delinquency and the Justice System. (3-0) Cr 3 F *Prereq 130 or 134* Analysis of meanings of juvenile delinquency Examination of the juvenile justice system Critical issues in juvenile justice and ways to approach the issues and possible solutions Fee

454 Field Observation and Practice Cr var F S SS *Prereq 201, 302, 305, and other courses deemed appropriate by faculty supervisor, junior or senior standing, cumulative GPA of at least 2.3, permission of instructor* Supervised practice in industrial plants, business organizations, human service agencies, rural organizations, and governmental agencies Offered on a satisfactory-fail basis only, except in those cases where a creative component, to be decided upon by the faculty supervisor and student, is completed Not more than 12 credits of field experience (Soc 454, 460, and 469) may be counted toward meeting the required 47 hours of upper level courses and the total of 124 5 credit hours required for graduation No credits in Soc 454 may be used to satisfy minimum sociology requirements for sociology majors

*A Rural Sociology
B General Sociology

460 Observation and Practice in Criminal and Juvenile Justice. Cr var F S SS *Prereq 201, 302, 305, either 340 or 440, and other courses deemed appropriate by faculty supervisor, junior or senior standing, cumulative GPA of at least 2 3, permission of instructor* Study of the criminal and juvenile justice systems and social control processes Supervised placement in a police department prosecutor's office, court, probation and parole department, penitentiary, juvenile correctional institution, community-based rehabilitation program, or related agency Offered on a satisfactory-fail basis only except in those cases where a special creative component, to be decided upon by the faculty supervisor and student is completed Not more than 12 credits of field experience (Soc 454 460 and 469) may be counted toward meeting the required 47 hours of upper level courses and the total of 124 5 credit hours required for graduation No credits in Soc 460 may be used to satisfy minimum sociology requirements for sociology majors

461. Sociology of the Life Cycle. (3-0) Cr 3 F *Prereq 130 or 134* Theoretical and empirical perspectives on individuals facing developmental tasks, age related norms, values, and subcultures Decisions and issues faced by individuals as they progress through stages of the life cycle

462 Social Work Skills and Strategies for Intervention in Small Systems. (4-0) Cr 4 F *Prereq Admission to social work program* General skills for social work problem assessment data collection strategies for intervention with individuals families, and small groups as target systems

463. Social Work Skills and Strategies for Intervention with Large Systems. (4-0) Cr 4 F *Prereq 261, credit or classification in 461, 462* Issues and skills for planned change in planning and allocation policy arenas regarding social provisions and social services, human service organizations and policy units from the local to the national level examined with respect to issue identification, policy objectives, organizational structure and processes, values, and evaluation.

*464. Community Action. (3-0) Cr 3 F S *Prereq 130 or 134* Community analysis of mobilization and organization of human and social system resources for social action programs

469. Social Work Practicum. Cr 12 S.SS *Prereq: 261, 461, 462, 463.* Field placement in selected social service agencies under professional supervision, where students relate knowledge base, generic skills, and professional development. Offered on a satisfactory-fail basis only.

473. Sociology of Youth. (3-0) Cr 3 S SS. *Prereq: 130 or 134.* Sociological analysis of development of youth subcultures in society; socialization in complex society and social implications of youth transition into adult culture.

476. The Aged in American Society. (3-0) Cr 3. S *Prereq: 130 or 134.* A survey of sociological problems of the aging and the social implications of a sizable aged population.

485. Sociology of the Family. (3-0) Cr 3 F S SS *Prereq 130 or 134* The family as a primary group in mass societies.

490. Independent Study. Cr 1 to 3 each time taken *Prereq. 6 credits in sociology, permission of instructor*
A. General Sociology
*B. Rural Sociology
C Social Problems
D Industrial Sociology
E. Family Sociology
F Leisure and Environmental Resources
G Sociology of Small Groups
H Honors
I Senior Seminar

Courses Primarily for Graduate students, major or minor, open to qualified undergraduates

511. Intermediate Research Methods. (2-2) Cr 3 F *Prereq: 302.* Research methods in sociology including both qualitative and quantitative approaches. problem selection, hypothesis formulation, designs, sampling, measurement, data collection and analysis, proposal writing

516. Qualitative Methodology. (3-0) Cr 3 Alt F, offered 1982 *Prereq. 6 credits in sociology* The art of qualitative data gathering and analytic techniques. Observation, participant-observation, case studies, in-depth interviews, life histories, life sculpting, content analysis. Videotape practice

517. Sociological Evaluation Research Methods. (3-0) Cr. 3. Alt F, offered 1982 *Prereq 6 credits in sociology.* Examination of methodological models and techniques appropriate to the sociological evaluation of planned social action programs implemented by legislation and/or human service organizations

520. Social Psychology: A Sociological Perspective. (3-0) Cr 3 F *Prereq: 305 or Psych 280* Examination of cognitive, symbolic interaction, exchange, role-reference group, and dramaturgical approaches Assessment of contemporary issues in social psychology

521. Small Groups. (3-0) Cr 3 Alt S, offered 1982 *Prereq. 305 or Psych 280* Examination of alternative theoretical models and methods of studying small groups

522. Attitude and Attitude Change. (3-0) Cr 3 Alt S, offered 1983 *Prereq 305 or Psych 280* Analysis of theories of attitude and attitude change; current controversies between the theories examined, as well as supporting research

527. Socialization. (3-0) Cr 3 Alt S, offered 1983 *Prereq 6 credits in sociology* Research and theory on human socialization throughout the life cycle Socialization studied as an organizational process, impacts of social change on socialization content and processes

529. Minority Groups. (3-0) Cr 3 Alt SS, offered 1982 *Prereq 6 credits in sociology* Perspectives in intergroup relations, ethnicity in the modern world, examination of theory and research on intergroup relations, implications of research for policy

530. Social Organization. (3-0) Cr 3 S *Prereq 6 credits in sociology.* Methodological and analytical issues associated with the study of group structure, contemporary theories of social organization, date analysis issues involving social organization

***532. Organizations and Their Environments.** (3-0) Cr 3 Alt. F, offered 1982 *Prereq. 6 credits in sociology* Comparative analysis of complex organizations. Complex organizations as semi-open systems. Interorganizational relations and organizational effectiveness.

***533. Models of Community.** (3-0) Cr 3 Alt F, offered 1981 *Prereq. 6 credits in sociology* Emphasis on different models or frames of reference used in community analysis Theoretical and methodological tools, current views of community problems, and explanation of social and cultural change presented for each model

***538. Sociology of Leisure.** (3-0) Cr 3. Alt. SS, offered 1982 *Prereq 6 credits in sociology* Theory and research on the patterns, correlates, and functions of leisure behavior Consideration of conceptual and methodological problems in studying leisure

***540. Contemporary Theories of Social Change.** (3-0) Cr 3 Alt F, offered 1982 *Prereq 6 credits in sociology* Contemporary theories of social change, modernization and development are critically examined, theoretical and methodological issues identified, supporting research explored, and, the applicability of theoretical models, concepts, and strategies to current national and international needs evaluated

546. Applied Sociolinguistics: Linguistic Problems of Developing Nations. (3-0) Cr 3 Alt S, offered 1982 *Prereq. 6 credits in sociology* Analysis of sociolinguistic problems and solutions in multilingual developing nations, language planning and adoption and diffusion of language policies, language problems in technological change

***548. Sociology of Environmental Resources.** (3-0) Cr 3. Alt SS, offered 1983 *Prereq 6 credits in sociology* Theory and research on contemporary environmental topics and issues, including social impact assessment, equity considerations in resource use, environmental quality movement, environmental values, energy conservation, land-use conflict, and natural resources management

550. Principles of Population. (3-0) Cr 3 Alt SS, offered 1982 *Prereq: 6 credits in sociology* Examination and critique of demographic theories, methods and techniques of measuring demographic phenomena, historical and current population trends, survey of current research on population

555. Human Ecology. (3-0) Cr 3 Alt SS., offered 1983 *Prereq 6 credits in sociology* Historical and theoretical development of human ecology Analysis of human settlements, social organization and the environment, and ecological methods

562. Social Deviance (3-0) Cr 3 Alt SS, offered 1983 *Prereq 6 credits in sociology* Examination of theory and research relevant to the meaning, identification, and causes of deviant behavior

564. Criminal and Juvenile Justice: Process and Institutions. (3-0) Cr 3. Alt S, offered 1982 *Prereq 6 credits in sociology* Examination of the criminal and juvenile justice systems The dynamics of contemporary police, judicial, correctional institutions, and community-based rehabilitation programs are evaluated in the context of key historical developments, theory, and research.

566. Political Sociology. (3-0) Cr 3 Alt SS, offered 1982 *Prereq. 6 credits in sociology* Analysis of power, mass society, and elite formation, ideology and its uses

575. The Family in Changing Societies. (3-0) Cr 3 Alt SS, offered 1983 *Prereq 6 credits in sociology* Analysis of the relationships of the family and other institutions, emphasis on rural-urban differences, the family in modern and changing societies.

576. Sociological Perspectives on Aging. (3-0) Cr 3 Alt F, offered 1981 *Prereq. 6 credits in sociology* Theoretical perspectives on the aging process, social and social-psychological changes accompanying aging, age considerations in American society

590. Special Topics. Cr 1 to 3 each time taken *Prereq 6 credits in sociology, senior or graduate classification*
*A. Rural Sociology
B General Sociology

591. Orientation to Sociology. (1-0) Cr R F Introduction to the department, current graduate student policies at department and university levels, departmental administrative procedures. Required of graduate students. Offered on a satisfactory-fail basis only

599. Research for Master's Thesis.
*A. Rural Sociology
B General Sociology

Courses for Graduate Students, major or minor

600. Intermediate Sociological Inquiry and Theory. (3-0) Cr 3 Alt F, offered 1982 *Prereq. 511* Units of sociological analysis. Taxonomies in sociology. concepts, subconcepts, levels of concepts Elements of systematic sociological theory; propositions, explanation, prediction, cause. Use of sociological theory in research

605. Historical Sociological Theory. (3-0) Cr 3 Alt F, offered 1982 *Prereq: 6 graduate credits in sociology* Evolution of sociological thinking focusing on the era from the Enlightenment to 1900. Positivism, conflict and functionalist traditions, organicism, and sociology of knowledge perspectives

607. Contemporary Sociological Theory. (3-0) Cr 3 Alt F, offered 1981 *Prereq 6 graduate credits in sociology* Survey of theoretical developments since 1900, including the rise of structural-functionalism symbolic interactionism, conflict theories, phenomenology, exchange theory and others

611. Sociological Measurement. (3-0) Cr 3 Alt S, offered 1982 *Prereq: 511* Principles of measurement for major sociological variables Foundations of measurement, types of sociological variables, construction of sociological measures, indices and scales, methods of data collection

***613. Advanced Theory Construction and Causal Modeling.** (3-0) Cr 3 Alt S, offered 1983 *Prereq 511 600* Contemporary theory construction in sociology, models in sociology, formal strategies to theory construction, notion of causality in sociology, contemporary approaches to causal analysis.

***642. Sociology of Adoption and Diffusion.** (3-0) Cr 3 Alt F, offered 1981 *Prereq: 6 graduate credits in sociology.* Sociological and social psychological theories related to adoption and diffusion of new ideas Analysis of adoption and diffusion models, methods of field research. Factors related to rates and intensity of adoption and diffusion Adopters' characteristics related to rates of adoption

***645. Applied Sociology.** (3-0) Cr 3 Alt S, offered 1983 *Prereq. 6 graduate credits in sociology* Orientation of applied sociology, roles and institutional settings of applied sociologists, application of sociological theory and research to social problems Emphasis is given to both rural and urban settings

698. Seminars in Sociology. (3-0) Cr 3 each
A. Social Theory and Research
B Methodology
*C Applied Sociology

699. Dissertation Research
*A Rural Sociology
B General Sociology

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*Administered through the College of Agriculture Courses not marked by an asterisk are administered through the College of Sciences and Humanities
†Credit from only one of 130 and 134 may be applied toward graduation.

Speech

Linda J Busby, Acting Chair of Department

Professors: Brandt, Dearin, Drexler, Underhill, Wilson

Associate Professors: Busby, Connolly, Gouran, Myers, Nelson, Weaver

Assistant Professors: Bliese, Chow, DeStephen, Griffith, Hoopes, Kaufmann, Kraemer, Langford, Navarro, Pearson, Perkins, Sorenson, Vallier, Venkatagiri, Waggoner

Instructors: Cox, Johnson, Steger, Stone

Undergraduate Study

The department offers introductory courses designed for all students as part of their general education, as a complement to professional training, and as an introduction to further study in the field

A student electing to major in speech may submit, in consultation with an adviser, a program of courses for either the Bachelor of Arts or the Bachelor of Science degree This program of courses may be of a general nature, or may emphasize study in any of the following areas communication disorders, interpersonal and rhetorical communication, telecommunicative arts, theatre, or speech education

To attain an undergraduate major in the Department of Speech, a student must present a minimum total of 24 credits in speech courses of which a minimum of 20 credits must be selected from courses at the 300 level or above A student majoring in the department must complete 9 credits in writing courses with at least a 2 0 average, including English 104 and 105 or the equivalent Majors are limited to a maximum of 9 credits from 490A, 490B, 490C, 490D, 490E, and 490H

Students who major in speech can prepare themselves for a wide variety of future employment opportunities, depending upon individual interests, background, and abilities Some may wish to prepare for positions in theatre, radio, television, film, education, communication disorders, or related fields in business and communication Alternately, students may select speech as a major in pursuit of a liberal arts education Programs in speech also can prepare students for graduate study An undergraduate speech major may be used as a background for medical, legal, theological, or other professional studies

Students are encouraged to participate in the co-curricular activities sponsored by the department These activities include Iowa State Forensics and the Iowa State University Theatre

Speech Education. Students fulfilling the requirements for teacher certification prepare to teach speech, dramatic arts, and media at the secondary school level In addition, they prepare to direct co-curricular and extracurricular activities

Each student seeking teacher certification in speech must fulfill the requirements outlined in the Sciences and Humanities Cross-Disciplinary Studies section of this bulletin In addition, each student must maintain a 2 5 grade point average in all courses taken in the Department of Speech and all credits taken in the Department of Speech must carry a grade of "C" or better

Communication Disorders

The curriculum is preprofessional and consists of course work in speech-language pathology and audiology, as well as study in related disciplines such as psychology, child development, learning disabilities, zoology, and linguistics In addition to this broad and basic academic background, the student has an opportunity to observe and participate as a student clinician in the Communication Disorders Clinic and acquire up to 150 clock hours of undergraduate clinical experience

Successful completion of the preprofessional program prepares the student for graduate study in this field A masters degree in communication disorders, additional supervised clinical experience at the graduate level, a clinical fellowship year, and a written competency exam are required beyond this program to practice the profession A student must plan to attend another school for graduate work

Interpersonal and Rhetorical Communication

The interpersonal and rhetorical communication area offers instruction to speech majors whose program emphasizes rhetorical and interpersonal communication as a field of study, and to students from various disciplines who seek to increase their understanding of communication theory and to improve their communication skills The principal content dimensions of the area are interpersonal, small group, organizational, and public communication Students emphasizing the area examine the processes and variables affecting communication in human relationships Focus is on planning, presenting, analyzing, and evaluating messages Communication may be studied from a critical perspective or from an experimental perspective

Emphasis in the area prepares students to teach speech in high school, study law or theology, attend graduate school, or enter a variety of communication-related areas in business organizations Communication internships in businesses are available to qualified students The area's courses also provide a minor concentration for students in allied fields such as business administration, English, journalism, or foreign languages and literatures

Telecommunicative Arts

The telecommunicative arts area includes television, radio, and film study Students may choose courses in production, direction, writing, editing, announcing, performance, history, theory, management, and criticism

The department maintains a unique relationship with two service units of the University that provide students in telecommunicative arts with modern studios and equipment Advanced students produce and direct television programs during the evening hours in the studios of WOI-TV, the university owned and operated commercial ABC-TV affiliate Advanced film production students utilize the equipment and facilities of the University Film Production Unit on Saturday mornings and during evenings The basic telecommunicative arts courses are taught in Exhibit Hall, which contains radio and television studios, classrooms, and offices

A student emphasizing telecommunicative arts is encouraged to take the following courses 130, 231, 233, one of 237 or 238, 236, 331, and at least one of 434, 532, or 533

Theatre

The theatre area offers a wide variety of courses in dramatic theory and production Students may select from a core of courses in acting, design, costume, make-up, lighting and sound, stage direction, theatre management, and theatre history Independent study and special topics courses supplement formal course offerings to provide opportunities to intensify study in a particular aspect of theatre

Students are urged to implement the theories and principles explored in the classroom Iowa State University Theatre regularly presents mainstage productions in Fisher Theater of the Iowa State Center The production program spans both the regular academic year and the summer sessions Auditions for University Theatre productions are currently open to all students irrespective of academic major Similarly, participation in areas of production other than acting is open to both departmental majors and nonmajors Qualified students also present experimental and laboratory productions

Merit and honor scholarships are awarded on a regular basis to students who make significant contributions to Iowa State University Theatre

Graduate Study

The department offers courses for a graduate minor in speech as well as supporting work for other fields Speech also participates in the interdepartmental program leading to a masters degree in General Graduate Studies

Open to graduate students for minor credit only 305, 327, 371, 376, 385, 412, 433, 434, 435, 465, 466, 475, 477, 479, 480

Courses Primarily for Undergraduate Students

Communication Disorders (Sp)

170 Speech Improvement. (1-0) Cr 1 F S SS Development of effective speech habits voice quality, articulation, expression, pronunciation

270 Speech and Hearing Science. (3-0) Cr 3 F Anatomy and physiology of respiration voice, resonance, articulation, and hearing as related to speech, language, and hearing

271 Phonetics. (3-0) Cr 3 F S Analysis of speech through study of individual sounds, their variations, and relationships in context, practice in auditory discrimination and transcription of sounds of American English, description of speech sounds in terms of their production, transmission, and perception

275. Introduction to Communication Disorders. (3-0) Cr 3 F S SS Survey of speech, language and hearing disorders of children and adults

290 Special Projects Cr 1 to 2 each time taken maximum of 4 credits *Prereq 3 credits in Speech permission of department chairman*
A Communication Disorders
H Honors

371 Language Development. (3-0) Cr 3 F *Prereq 275* Developmental process of language and speech acquisition in children, pragmatics of children s communication

376 Articulation Disorders. (3-0) Cr 3 F *Prereq 270 271, 275* Nature, etiology, assessment and management of disorders of speech sound production

379 Clinical Management of Communication Disorders (3-0) Cr 3 F *Prereq 275* Principles and methods employed in the clinical management of communication disorders, preparatory for clinical practicum For those planning a career in communication disorders

385 Audiology (3-0) Cr 3 S *Prereq 270, 275* Nature etiology, and assessment of hearing disorders

475 Neurogenic Communicative Disorders. (3-0) Cr 3 S *Prereq 270, 275* Nature, etiology, assessment, and management of neurogenic communicative disorders

477 Fluency Disorders. (3-0) Cr 3 F *Prereq 275* Nature, etiology, assessment and management of fluency disorders

479 Practicum in Communication Disorders. Cr 1 to 2 each time taken, maximum of 4 F S SS *Prereq 379, 376 or 477 or 480, grade point average of 3 0 in communication disorders courses, permission of instructor*

480 Language Disorders of Children. (3-0) Cr 3 F S SS *Prereq 371* Nature, etiology, assessment and management of disorders of language in children and adolescents

490 Independent Study Cr 1 to 3 each time taken *Prereq 9 credits in speech, junior classification, permission of department chairman*
A Communication Disorders
H Honors

Interpersonal and Rhetorical Communication (Sp)

***211 Fundamentals of Speech Communication.** (3-0) Cr 3 F S.SS Principles of communication; practice in preparation and delivery of extemporaneous speeches, additional practice in interpersonal communication

***212 Fundamentals of Public Speaking.** (2-0) Cr 2 F S SS Principles of rhetoric in an advocacy situation,

audience analysis, interest and attention, selection and organization of speech material, style, and delivery Practice in preparation and delivery of extemporaneous speeches.

215. Parliamentary Procedure. (2-0) Cr 2 F S Principles and forms of parliamentary action governing conduct of meetings. Practice in procedures for small groups as well as for larger deliberative assemblies

223. Intercollegiate Debate and Forensics. Cr 1 each time taken, maximum of 6 credits. F S *Prereq. Permission of instructor.* Participation in intramural or intercollegiate debate and other forensic events

225. Nonverbal Communication. (3-0) Cr 3 F S.SS Introduction to nonverbal communication, paralinguistics, proxemics, kinesics, symbolism, signs, and object language.

290. Special Projects. Cr 1 to 2 each time taken, maximum of 4 credits *Prereq. 3 credits in speech, permission of department chairman*
B Interpersonal and Rhetorical Communication
E Speech Education
H Honors

305. Semantics. (3-0) Cr 3 F S SS *Prereq Engl 105* Nature of symbolic processes, determination of meanings, major approaches to linguistic study, impact of verbal habits in human affairs, relationships between language and thought in personal or social problems, accuracy in use of verbal symbols

311. Interpersonal Communication. (3-0) Cr 3. F S.SS *Prereq 211* Theory and principles of communication in interpersonal settings perception, verbal and nonverbal language, the role of self and others in the communication process, cultural and subcultural differences, and rhetorical bases of effective communication.

312. Business and Professional Speaking. (3-0) Cr 3 F S SS *Prereq. 211 or 212* Principles and practice in common types of professional presentations briefings, motivational, sales, manuscript, and public relations presentations

313. Communication for the Classroom Teacher. (3-0) Cr 3. S.SS. *Prereq: 211 or 212* Communication in the teaching profession, training in classroom-oriented communication activities, use of video recorder for analysis of presentation

314. Organizational Communication. (3-0) Cr 3 S SS *Prereq. 211* Behavioral research and theories in organizational communication, communicative strategies for effective organizational functioning, application through related exercises

315. Interviewing. (3-0) Cr 3 F SS *Prereq: 211* Theory and practice of communication in various kinds of business interviews, application of speech communication theory and concepts to the interview setting

317. Group Discussion and Leadership. (3-0) Cr 3 F S SS *Prereq 211* Development of communication skills in the practice and procedures of information-sharing, problem-solving, and decision-making groups Theories and techniques of leadership as applied to small group settings

322. Argumentation and Debate. (3-0) Cr 3 F SS *Prereq 211 or 212* Practice in preparing and presenting argumentative and debate speeches; emphasis on ethical and logical duties of the advocate, analysis, evidence, reasoning, attack, defense, research, case construction, and judging.

327. Persuasion. (3-0) Cr 3 F S.SS *Prereq: 211 or 212* Examination of behavioral research in persuasion, scientific methods of evaluating persuasive communication, emphasis on application of experimental research: audience analysis, attention, perception, suggestion, logical, emotional and ethical proofs.

412. Speech Criticism. (3-0) Cr 3. F *Prereq: 211 or 212, and 6 credits of Speech* Development of rhetorical theory and practice from Corax to modern times Application of principles of criticism to current public speaking practices.

416. American Public Address. (3-0) Cr 3 S. *Prereq 412.* Relationship between public persuasions and leaders; process of preparing major public addresses, selected speakers and speeches as linked with political or historical events.

417. Campaign Rhetoric. (3-0) Cr 3. Alt. F , offered 1982. *Prereq: 211 or 212.* Backgrounds of candidates for state and national elections, selected speeches and issues; persuasive strategies and techniques of individual speakers.

490. Independent Study. Cr 1-3 each time taken *Prereq: 9 credits in speech, junior classification, permission of department chairman*
B Interpersonal and Rhetorical Communication
E Speech Education
H Honors

495. Teaching Speech. (3-0) Cr 3 F *Prereq. Sec Ed 301, 12 credits in speech, minimum grade point average of 2 5 in speech courses.* Problems, methods, and materials related to teaching speech, theatre, and media in secondary school Particular attention to co-curricular and extra-curricular programs

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***Credit for both 211 and 212 may not be applied toward graduation.**

Telecommunicative Arts (Sp)

130. Telecommunicative Arts Seminar (1-0) Cr 1 each time taken, maximum of 3 credits F S Orientation to radio-television-film Presentation and guest lecturers from the field of commercial and educational media Offered on a satisfactory-fail basis only

231. Radio Workshop. (2-2) Cr 3 F S SS *Prereq Engl 105* Introduction to radio techniques and equipment usage, format production, announcing, writing, use of sound effects, and music Practice in integrating various audio elements in production of radio programs

232. Systems Characteristics of Audio, Video, and Film (2-2) Cr 3 F Factors that determine our perception of the aural and visual environment; principles involved in the operation of audio, video, and film systems, analysis and manipulation of those factors that affect sound and visual information in these systems.

233. Beginning Television Production/Direction (2-2) Cr 3 F S Lectures Aspects of directing and producing television programs, video and audio elements Laboratory Producing and directing television programs and serving as members of the production/direction team

236. Television Production. (3-1) Cr 3 F *Prereq 233* Procedures for planning and producing television programs Program types analyzed for use of audience appeals and production values

237. Survey of Film History: 1900-Present. (2-2) Cr 3 F *Prereq Engl 105.* The theoretical and technical developments of the motion picture (Additional screenings required)

238. Cinema in the United States. (2-2) Cr 3 S *Prereq Engl 105* Analysis of the technical, social, economic, and ideological structures of the United States film industry from 1900 to the present Hollywood, underground, and governmental film production (Additional screenings required)

290. Special Projects. Cr 1 to 2 each time taken, maximum of 4 credits. *Prereq. 3 credits in speech, permission of department chairman*
C Telecommunicative Arts
H Honors

319. Motion Picture Techniques. (Jl MC) See *Journalism and Mass Communication*

330. Intermediate Radio Production. (2-2) Cr 3 S *Prereq 231* Lectures and discussion of contemporary radio, broadcast formats, contemporary issues, and production techniques. Production of several program formats for airing on commercial and public radio stations.

331. Broadcasting in America. (3-0) Cr 3 S.SS *Prereq Junior classification* The American structure of radio-television and related industries, analysis of types of programs, roles of broadcasting in entertainment, public service, and economics, study of history of broadcasting and standards of media evaluation

332. Television and Radio Speech. (2-2) Cr 3 F SS *Prereq. 211 or 212* Theory and practice of effective television and radio communication

333. Intermediate Television Production/Direction. (2-2) Cr 3. S. *Prereq. 233.* Lectures Television aesthetics, set design, lighting, production, and direction techniques. Laboratory Utilization of all TCA television equipment in production and direction of a variety of program formats.

336. Film Theory. (2-0) Cr 2 Alt S , offered 1982 *Prereq. A 3-credit course in film* Survey of major film theories. Analysis and application to contemporary films. (Additional screenings required)

337. Television Performance. (1-4) Cr 3 S *Prereq. 231 or 233.* Problems of the television performer; adaptations in composition and interpretation that the medium requires of the announcer, narrator, master of ceremonies, or actor Studio situations designed to aid students in improving performance skills.

338. Film-Television Critical Analysis. (3-0) Cr 3 F *Prereq: 3 credits in film.* Nonprint media analyzed through various critical methodologies, study of contemporary critics and critical theory

341. Television Programming: Management. (3-0) Cr 3 S. *Prereq 331* Analysis of the decision-making processes in selecting, scheduling, financing, and distributing broadcast television programs

400. Studies in Film. (Engl 400) See *English*

433. Advanced Television Production/Direction. (1-4) Cr 3 F *Prereq: 333* Procedures for planning, producing and directing television programs Emphasis on translation of facts, ideas, emotions and attitudes into meaningful images

434. Film Production and Structure. (3-0) Cr 3 S *Prereq Jl MC 319.* Survey of film production with emphasis on relationship between writing and total production process. Exercises designed to develop skills in conceptualization, scripting, and continuity and to relate filmic form and content to styles of direction cinematography, lighting, sound, and editing

435. Intermediate Film Production. (2-2) Cr 3 F *Prereq 434* Practical experience in technique of film production Preproduction planning, budgeting, production management, location and sync-sound filming, sound recording, transfers, mixing, and editing Emphasis on professional production procedures

439. Documentary in Film and Television. (2-2) Cr 3 F *Prereq One 3-credit course in film* Analysis of purpose styles, and structures of the film-video documentary (Additional screenings required)

490. Independent Study. Cr 1-3 each time taken *Prereq 9 credits in speech, junior classification, approval of faculty sponsor and department chairman*
C Telecommunicative Arts
H Honors

Theatre (Sp)

106. Introduction to the Performing Arts. (3-0) Cr 3 F S SS Broad-based, team-taught survey of the performing arts that includes segments on theatre, television, radio, film, dance, and music

151 Theatre Speech. (3-0) Cr 3 F Study of fundamentals of theatre speech vocal strength and quality, skills of articulation, tonal awareness and control, with emphasis on stage dialects

224. Concert and Theatre Dance. (Dance 224) See *Physical Education, Dance*

250. Theatre Practice. Cr 1 or 2 each time taken, maximum of 6 credits F S SS *Prereq Permission of instructor* Practice in acting, directing, costuming, makeup, scene construction, painting or scene design

251. Beginning Acting. (3-0) Cr 3 F S SS Theory and practice in fundamentals of acting

255. Fundamentals of Modern Theatre Practice. (3-2) Cr 4 S Basic practices, procedures, and techniques of stagecraft, directing, design, scenic painting, stage lighting, costume, and makeup, laboratory in practical application

290. Special Projects. Cr 1 to 2 each time taken, maximum of 4 credits *Prereq 3 credits in speech, permission of department chairman*
D Theatre
H Honors

316. Playwriting. (Engl 316) See *English*

351 Intermediate Acting. (3-0) Cr 3. Alt. S , offered 1982 *Prereq. 251, Dance 120* Intensive theory and practice of acting, emphasis on character and scene analysis

356. Costuming for Stage, Television, and Film. (3-0) Cr 3 F *Prereq 255* Costume history, design, and construction for theatre, television, and film.

357. Stage Make-up. (1-4) Cr 3 S.SS. Basic theories and techniques of stage make-up and theatrical hair styling

358. Oral Interpretation. (3-0) Cr 3 F S. Principles of oral interpretation, practice in analysis and reading aloud of literary selections and practice in readers theatre

359. Theatre for Children. (3-0) Cr 3. S. Principles of producing theatre for children, participation in a mainstage production for children

360. Stagecraft. (3-2) Cr 4. F *Prereq. 255.* Tools, materials, and techniques in constructing and painting scenery; technical drawing for constructing scenery

361 **Scene Design.** (3-0) Cr 3 Alt. S , offered 1983 *Prereq 360* Principles and practice in creating visual environment for performance of dramatic literature

362. **Creative Dramatics.** (3-0) Cr 3 F S SS *Prereq Junior classification* Storytelling, improvisation and playmaking with children and adults

364. **Lighting and Sound.** (3-0) Cr 3 Alt S , offered 1982 *Prereq 360* Theories and practice in design, use of lighting and sound for the stage

452. **Arts Management.** (3-0) Cr 3 F *Prereq 6 credits in the visual or performing arts* Principles of management, finance, public relations, and publicity as they apply to problems and practice in the performing and visual arts Field trip fee required

455. **Directing.** (2-0) Cr 2 F *Prereq 255, 360* Theory and techniques of stage directing

465. **History of Theatre I.** (3-0) Cr 3 F *Prereq Hist 201* Theatrical art from ancient times to 1800

466. **History of Theatre II.** (3-0) Cr 3 S *Prereq 465* Theatrical art from 1800 to present

469 **Theatre Practicum.** Cr 1 to 2 each time taken, maximum of 6 credits F S SS *Prereq 9 credits in theatre courses, junior classification and theatrical experience* Practicum in theatre including musical, stock, or repertory theatre involving production, rehearsal, and performance with opportunities for specialization within various areas

490. **Independent Study.** Cr 1 to 3 each time taken *Prereq 9 credits in speech, junior classification, permission of department chairman*
D Theatre
H Honors

Courses Primarily for Graduate Students, Major or Minor, open to qualified undergraduates.*

504 **Seminar** Cr 1 to 3 each time taken F S SS *Prereq 9 credits in speech* Topics may be included in the following areas
A Communication Disorders
B Interpersonal and Rhetorical Communication
C Telecommunicative Arts
  1 Mass Media and Society
  2 Women, Minorities, and Mass Media
  3 Broadcast Survey Research
  4 Film in Third World Culture
  5 Women and Cinema
D Theatre
E Speech Education

510 **Classical Rhetoric.** (3-0) Cr 3 S *Prereq 12 hours of speech* Greek and Roman tradition in rhetorical theory, practice, criticism, and pedagogy

532 **Radio Research and Programming.** (2-2) Cr 3 each time taken, maximum of 6 credits S *Prereq 330 or graduate classification* Research methods, program formats, directing, and management principles as related to radio

533 **Broadcast Program Production** (2-3) Cr 1 to 3 each time taken, maximum of 6 credits S *Prereq 433* Topics selected by students for half-hour programs Research, planning, production, and direction in WOI studios

536. **Film Practicum.** (1-6) Cr 3 each S *Prereq 435* Application of production techniques in a complete 16 mm sound film project of professional quality Students work together as crew members as the project evolves from conception to completion including research, scripting, filming, sound recording, animation, editing, and the post production functions

551 **Advanced Acting.** (3-0) Cr 3 Alt S , offered 1983 *Prereq 351* In-depth study and practice of period pieces and acting styles

555. **Directing Practicum.** (1-2) Cr 2 S *Prereq 455* Practical experience in directing the stage play

556. **Directing the Educational Theatre Program.** (3-0) Cr 3 SS *Prereq Graduate classification, permission of instructor* Problems in directing educational theatre, play selection and new dramatic literature, theatre management, directing college and high school drama programs, conducting high school drama contests and festivals

563. **Theory and Criticism of Dramatic Production.** (3-0) Cr 3 SS *Prereq 6 credits in theatre or dramatic literature* Examination of critical theories of play production from Aristotle to modern critics

590. **Special Topics.** Cr 1 to 4 each time taken, maximum of 12 credits *Prereq Permission of department chairman*
A Communication Disorders
B Interpersonal and Rhetorical Communication
C Telecommunicative Arts
D Theatre
E Speech Education

599. **Research.**

*Open to junior and senior-level students with a grade point average above 3.0

Statistics

Herbert A David, Head of Department

Professors: Athreya, C P Cox, D F Cox, H A David, H T David, Fuller, Ghosh, Groeneveld, Han, Harville, Hickman, Hinz, Hotchkiss, Isaacson, Kempthorne, Kennedy, Meeden, Pollak, Sposito, Strahan, Wolins

Emeritus Professors: Bancroft, Huntsberger, Strand

Associate Professors: Bailey, Booth, Meeker

Assistant Professors: Baker, Bubolz, Goebel, Johnson, Koehler, Lorenz, Marasinghe, Shelley, Stephenson, Sukhatme

Undergraduate Study

For the undergraduate curriculum in sciences and humanities, major in statistics, leading to the degree Bachelor of Science, see *Sciences and Humanities, Curriculum* For the undergraduate curriculum in biometry see *Agriculture, Curricula*

The curriculum in sciences and humanities with a major in statistics is designed to prepare students for (1) graduate study in statistics, and (2) positions in business, industry, or government This work may include the following statistical design, analysis, and interpretation of experiments and surveys, statistical quality control, sample inspection, high-speed data processing, application of statistical principles and methods to industrial research and development, and to industrial design and specifications, operations research to analyze the performance of persons, machines, and processes under operational conditions, market, sales, advertising, and consumer research, cost and price analyses, newspaper, magazine, radio, and television research, psychological testing, public health studies Also, there are opportunities for work in statistics that require a major in a subject-matter field and a minor in statistics

Undergraduate majors in this department usually include the following basic courses in their programs 101, 341, 342, 401, 402, 421, 480, 481 These courses plus two additional statistical courses at the 400 level or above constitute the major It is advisable to have a minor in a field of application

The curriculum in biometry is intended for those students who desire to apply mathematics and statistics to problems related to agriculture The curriculum prepares the student to work with research scientists in agriculture, or for graduate study in related fields

Students intending to do graduate work in statistics normally would take additional courses in mathematics

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with major in statistics, and minor work for students majoring in other departments Within the statistics major the student may specialize in experimental design, probability, statistical methods, statistical theory, statistical computing, survey sampling, or applied statistics (e g , biometrics, econometrics, psychometrics, sociometrics, etc) A specialization in operations research is co-offered with the Department of Industrial Engineering The doctor of philosophy degree is offered as a co-major with other departments Such departments have included Agricultural Engineering, Agronomy, Animal Science, Economics, Forestry, Genetics, Industrial Engineering, Psychology, and Mathematics

Prerequisite to major graduate work is the completion of an undergraduate curriculum essentially equivalent to the curriculum in sciences and humanities at this institution including at least a year of calculus

The degree Master of Science may be earned on either a thesis or nonthesis basis The nonthesis option requires the completion of at least 34 credits of acceptable graduate work and satisfactory performance on a written examination

The department encourages students to prepare themselves in foreign languages and in computer language, but specific requirements for the degrees master of science and doctor of philosophy are at the discretion of the student's advisory committee

Open to graduate students for minor credit only 401, 402, 403, 404, 405, 407, 421, 431, 432, 436, 447, 451, 480, 481

Courses Primarily for Undergraduate Students

100. **Orientation in Statistics and Biometry** (1-0) Cr R F Opportunities, challenges, and the scope of the curriculum in statistics and biometry For students planning or considering a career in these areas

*101 **Principles of Statistics.** (3-2) Cr 4 F S *Prereq 1½ years of high school algebra* Statistical concepts in modern society, frequency distributions, the normal distribution, elements of statistical inference, estimation and hypothesis testing, contingency tebles, linear regression and correlation, analysis of variance

*104 **Introduction to Statistics.** (2-2) Cr 3 F S SS *Prereq 1½ years of high school algebra* Statistical concepts with emphasis on experimental problems from biological fields. Summarizing statistical data, the normal distribution, estimation and tests of hypotheses, regression and correlation analysis, simple analysis of variance For students in the agricultural and biological sciences

*105. **Introduction to Statistics.** (2-0) Cr 2 F S *Prereq Math 165 or 175* Statistical concepts with emphasis on engineering applications Probability, distributions and their properties, elements of statistical inference, regression For students in engineering

*227. **Introduction to Business Statistics.** (3-2) Cr 4 F S *Prereq Math 150 or 165* Obtaining, presenting, and organizing statistical data, measures of location and dispersion, probability concepts, the normal distribution, sampling and sampling distributions, estimation and tests of hypotheses, simple linear regression analysis.

228. **Applied Business Statistics.** (2-2) Cr 3 F S *Prereq 101 or 227* Application of statistical methods to problems in business and economics, multiple regression, time series analysis and forecasting, analysis of variance, elements of experimental design, chi square tests, introduction to quantitative decision making, nonparametric inference

231 **Probability and Statistical Inference for Engineers.** (4-0) Cr 4 S *Prereq: Math 166 or 176.* Emphasis on engineering applications basic concepts, distributions,

transformations and propagation of error Statistical inference· point estimation; confidence intervals, hypothesis testing; goodness of fit, linear regression, design of experiments, analysis of variance; quality control.

300. Cooperative Education. Cr R *Prereq: Permission of department head.* Off-campus work periods for undergraduate students in a field of statistics

305. Engineering Statistics. (3-0) Cr. 3 S. *Prereq: Math 165 or 175.* Statistical inference, linear regression, design of experiments and the analysis of variance

341, 342. Introduction to Theory of Probability and Statistics. (3-0) Cr. 3 each 341; F S., 342; F S *Prereq 341: Math 265 or 371; 342: 341, Math 307* Probability, distribution functions and their properties; sampling distributions; theory of estimation and tests of hypotheses, linear hypothesis theory, regression and correlation, the multivariate normal distribution, nonparametric methods, sequential analysis

401. Statistical Methods for Research Workers. (3-2) Cr 4 F S.SS *Prereq· 101 or graduate classification* Statistical concepts and models, estimation, hypothesis tests with continuous and discrete data, simple and multiple linear regression and correlation, introduction to analysis of variance

402. Statistical Design and the Analysis of Experiments. (2-2) Cr 3 S SS. *Prereq 401* The role of statistics in research and the principles of experimental design Experimental units, randomization, replication, blocking, subdividing and repeatedly measuring experimental units, factorial treatment designs and confounding, extensions of the analysis of variance to cover general crossed and nested classifications and models that include both classificatory and continuous factors

403. Nonparametric Statistical Methods. (2-0) Cr 2 Alt F , offered 1982 *Prereq 228 or 401* Groeneveld Analysis of data when dependent variable has ordinal or nominal properties, statistical inference for ranked data, rank correlation, efficiency of nonparametric procedures and robustness of comparable parametric procedures

404. Statistics for the Social Sciences. (2-2) Cr 3 F *Prereq. 401* Application of statistical methods to data in the social sciences, generalized linear regression models, covariance, miscellaneous estimation problems, path analysis, constructing composite measures, procedures with measurement error present

405. Applied Econometric Statistics. (2-2) Cr 3 S *Prereq 401.* Hickman. Linear regression models containing classification and continuous variables, analysis of variance, dummy variables, grafted polynomials, generalized least squares, autocorrelation, lagged variables, introduction to simultaneous equations, two-stage least squares

407. Methods of Multivariate Analysis. (2-0) Cr 2 F *Prereq. 402, knowledge of matrix algebra* Techniques of analyzing multivariate data including Hotelling's T^2, multivariate analysis of variance, principal components, cluster analysis

421. Survey Sampling Techniques. (2-2) Cr 3 S *Prereq 228 or 401* Methods of designing and analyzing survey investigations, simple random, stratified, multistage, and multiphase sampling designs, methods of estimation including ratio and regression, construction and use of sample frames, organization of field work; data processing.

431. Statistical Methods in Quality Control. (2-0) Cr 2 F *Prereq 228 or 231 or 401* Single sampling plans for mean and attributes, sequential sampling, continuous sampling; control charts and process control

432. Applied Probability Models. (3-0) Cr 3 F *Prereq 231 or 341* Probabilistic models in engineering and the physical sciences, probability; Markov chains, Poisson and renewal processes, applications to queueing, scheduling, control, reliability, and other quantitative problems

436. Genetic Statistics for Research Workers. (3-0) Cr 3. F *Prereq. 402.* Bailey Statistical concepts in quantitative genetics. Derivation, definition and estimation of genetic parameters Applications of statistical models to the design, analysis and interpretation of quantitative genetic experiments Genetic and statistical implications of common selection procedures.

446, 447. Statistical Theory for Research Workers. 446: (2-0) Cr. 2. F. *Prereq: Math 142 and graduate classification, 447* (3-0) Cr. 3. S.SS. *Prereq: 446 or Math 166.* Primarily for graduate students not majoring in statistics. Emphasis on aspects of the theory underlying statistical methods. Probability, population distribution functions and their properties, sampling distributions, orthogonal linear functions, estimation, tests of hypotheses, regression, introduction to analysis of variance

451 Applied Time Series. (3-0) Cr 3 S. *Prereq 228 or 401* Meeker Methods for analyzing data collected over time, review of multiple regression analysis Elementary forecasting methods moving averages and exponential smoothing, adaptive methods Decomposition and seasonal adjustment of time series data. Autoregressive-moving average (Box-Jenkins) models. identification, estimation, diagnostic checking, and forecasting

480. Statistical Applications of Digital Computers. (3-0) Cr 3 F *Prereq 101, 104 or classification in 401, Com S 172 or knowledge of FORTRAN* Techniques of programming for statistical applications Programming in algorithmic languages Efficiency and numerical accuracy in algorithms Introduction to Monte Carlo methods and statistical techniques in simulation Principles of numerical analysis

481. Computer Processing of Statistical Data. (3-0) Cr 3 S *Prereq 401, Com S 172 or knowledge of FORTRAN* The computer as a tool for statistical data analysis Data structuring, file manipulation, and use of various data storage media. Algorithms, structure, and content of statistical packages Advanced techniques in use of statistical software systems

490. Independent Study. Cr Var *Prereq 10 credits in statistics*
H Honors

***Any student may receive credit toward graduation for only one of the courses 101, 104, 105 or 227.**

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

500. Statistical Methods. (3-2) Cr 4 F *Prereq 101 and credit or classification in 542 and 579* Hinz, Koehler Introduction to methods and analyzing data from experiments and surveys Methods of analysis of variance including cross classifications, correlation, multiple regression, introduction to multiple comparisons, covariance, contingency table analysis Current computer software utilized in data analyses

501. Multivariate Statistical Methods. (3-0) Cr 3 S *Prereq 500 or 402, 447 or 542, knowledge of matrix algebra* Koehler Elementary theory and techniques of analyzing multivariate data including Hotelling's T^2, multivariate analysis of variance, principal components, linear discrimination, canonical correlation Analysis of categorical data including log-linear and logistic models

511. Theory and Application of Linear Models. (3-0) Cr 3 S *Prereq 500 or 402 or 404 or 405, 542 or 447, a course in matrix algebra* Harville, Kempthorne Standard functional and classificatory models, matrix preliminaries, identifiability and estimability, intermediate theory of least squares and of best linear unbiased estimation, analysis of variance and covariance, reparameterization, multiple comparisons, variance components, elementary randomization models and analysis

512. Design of Experiments. (3-0) Cr 3 F *Prereq 511* Kempthorne, Harville Basic ideas of experimental design with applications; completely randomized design, randomized block design, randomization theory, estimation and tests, analysis of covariance with these designs, Latin square design, elementary combinatorics with Galois fields, randomization analysis, factorial experiments, confounding, fractional replication, split-plot designs; incomplete block designs in general, balanced and partially balanced designs, associated mixed linear models, intra- and inter- block information, strategies in factor screening, determination of optimum factor combinations, basic ideas of optimal design

521. Theory of Sample Surveys I. (3-0) Cr 3. S *Prereq 401, 447 or 542.* Goebel. Basic concepts and theory of designing sample surveys for finite populations, estimation of means, totals, proportions, variances, and covariances, frequently used designs such as simple random, stratified, systematic, cluster, and multistage sampling; ratio and regression methods of estimation.

522. Theory of Sample Surveys II. (3-0) Cr 3 Alt F , offered 1982 *Prereq: 521* Goebel. Further topics in design and estimation; unequal probability sampling, optimal stratification, multipurpose surveys, ratio and regression methods involving several auxiliary variables, double sampling, sampling over time, nonsampling errors and variance estimation for complex designs.

531. Sequential Product and Process Control (I E 531) (3-0) Cr 3 , Alt. S., offered 1983 *Prereq 343 or 447* Sampling, sequential analysis, estimation, Bayesian sampling, continuous sampling, and process control

533. Reliability (I E 533). (3-0) Cr 3 Alt S , offered 1982 *Prereq 231 or 342 or 432 or 447* H T David Ghosh Probabilistic modeling and inference in reliability; replacement, maintenance and inspection policies, applications

534. Ecological Statistics. (2-0) Cr 2. Alt S , offered 1983 *Prereq. 447 or 542* Pollak. Models of population growth, growth of populations with two competing species, parasite-host and predator-prey relationships elementary population genetics, selection, mutation and migration, spatial patterns in populations with one or more species, diversity; information theory

535. Biological Statistics. (2-0) Cr 2 Alt SS , offered 1983 *Prereq. 401 or 500* C. P Cox Direct and indirect biological assay; dose response curves, estimations from standard curves, parallel line and slope ratio assay; experimental designs for bioassay, multiple assays, quantal response assay analyses, radioimmunoassay; other biostatistical procedures according to student interests

536, 537. Genetic Statistics. (Gen 536, 537) (2-0) Cr 2 each 536. Alt. F , offered 1981, 537 Alt S , offered 1982 *Prereq. 402, 448, Gen 320 or 330 or 460, permission of instructor.* Pollak. Probability applied to genetic systems, random mating, selection and mutation, theory of inbreeding, some effects of finite population size, models for quantitative inheritance, partition of genotypic variance, covariances among relatives with random mating and selfing, experimental designs for evaluating parameters, phenotypic selection for quantitative traits

538. Econometric Statistics. (Econ 538) (3-0) Cr 3 F *Prereq. 447* Fuller Generalized linear regression Dummy variables, prediction Measurement error models Simultaneous equation systems Autoregressive and moving average time series Prediction Regression equations with time series errors

539 Game Theory. (Econ 539, I E 539) (3-0) Cr 3 F *Prereq 231 or 342 or 432 or 447* H T David Zero-sum two person games, games of timing, relation to mathematical programming, non-cooperative and cooperative n-person games

540. Operations Research Methods and Economic Analysis. (3-0) Cr 3 S *Prereq 539 or I E 511 or Econ 537* Sposito Methods and applications of selected techniques in nonlinear programming, including linear convex and quadratic programming Applications in economics and operations research

542, 543. Theory of Probability and Statistics. (3-0) Cr 3 each, Yr *Prereq. 542 341 and Math 414 or 465, 543. 542* Athreya, H A. David, Ghosh, Meeden Probability and distribution theory, common parametric families of distributions, elementary limit theorems, order statistics, central and non-central sampling distributions, introduction to the multivariate normal distribution, theory of point estimation including Bayes and minimax estimation, confidence intervals, classical and sequential hypothesis testing, and nonparametric inference

544. Bayesian Decision Theory. (3-0) Cr. 3 Alt SS , offered 1982 *Prereq. 543.* H T David, Meeden Introduction to decision theory; risk sets, admissible strategies, randomized strategies, complete classes, Bayes and minimax strategies, examples of Bayes strategies, comparison of Bayesian and classical theories; exchangeability; estimation of the multivariate normal mean

546. Theory of Nonparametric and Asymptotic Methods (3-0) Cr 3 Alt S , offered 1983 *Prereq. 542* Sukhatme Introduction to nonparametric problems, 1-sample, 2-sample and c-sample problems; tests based upon sample distribution functions, K-S and C-S tests, rank tests, tests for location, scale and independence, local properties of rank tests. Convergence of a sequence of a random variable and a sequence of distribution functions, limit theorems; asymptotic distributions of sample quantiles, U-statistics, rank tests, chi-square and other goodness of fit tests, Chernoff-Savage theorem, asymptotic efficiency of tests.

579. Introduction to Computer Hardware and Software Systems for Statistical Computing. (1-0) Cr 1 F *Prereq Graduate classification in statistics or consent of instructor* Kennedy. Designed to introduce students to the languages and conventions required for the use of the leading software systems in statistical computing Both batch and interactive modes of usage are considered

580. Statistical Computing. (3-0) Cr 3 F *Prereq 500, 542 and knowledge of a scientific programming language* Kennedy Seminumerical and numerical methods used in statistical computing Application areas discussed include probability function approximation, simulation, and linear and nonlinear least squares methods

590. Special Topics. Cr Var
A Theory
B Methods
C Design of Experiments
D Design of Surveys

Courses for Graduate Students, major or minor

601 Advanced Statistical Methods. (3-0) Cr 3 Alt F, offered 1981 *Prereq 501 and 447 or 543* C P Cox Linear model regression analyses, general orthogonal polynomials, differential variance regression, reverse estimation, essentially linear regression Parametrically non-linear regression Gauss-Newton and Marquardt procedures Multivariate analyses for continuous and discrete data. Analyses of higher order contingency table data.

611 Advanced Linear Model Theory. (3-0) Cr 3 F *Prereq 511, 543, course in matrix algebra* Harville, Kempthorne Advanced theory of least squares and best linear unbiased estimation, non-central chi-square and F distributions, distribution of linear and quadratic forms, F test, confidence regions, extensions of best linear unbiased estimation theory to mixed and random models and to non-standard settings, biased estimation, recursive estimation, inference for variance components

612. Advanced Design of Experiments. (3-0) Cr 3 Alt S, offered 1983 *Prereq 512, 611* Kempthorne, Harville Advanced randomization theory of experimental designs, Galois fields and use of these, mathematics of factorial designs, general treatment of partially balanced designs, including quasi-factorials and other types, designs for 2-way error control, sequences of treatments, changeover designs, general theory of optimal design, optimality of certain balanced designs

621 Advanced Theory of Survey Sampling. (3-0) Cr 3 Alt S, offered 1983 *Prereq 522* Advanced topics of current interest in design of surveys and analysis of survey data, unequal probability sampling with and without replacement, criteria for choice of survey strategies including sufficiency, likelihood, and admissibility, super population models and their role in choice of optimal strategies, review of recent literature

639 Stochastic and Abstract Programming (3-0) Cr 3 Alt SS, offered 1983 *Prereq 540* H T David, Sposito Distribution of game values and program optima, models for programming under uncertainty Dual and weakly dual programs in linear spaces Applications in probability and statistics

642. Measure Theory and Probability. (3-0) Cr 3 S *Prereq 542, Math 514* Athreya, Isaacson Probability measure and distribution functions, random variables, characteristic functions, laws of large numbers, asymptotic distributions, martingales

643 Theory of Estimation and Testing of Hypotheses. (3-0) Cr 3 F *Prereq 543, 642*. Ghosh, Meeden Asymptotic theory of maximum likelihood estimation, elements of decision theory; sufficiency; unbiased estimation, Neyman-Pearson theory of testing hypotheses, invariance

645. Order Statistics. (3-0) Cr 3 Alt F, offered 1981 *Prereq 543* H A. David Distribution theory and moments of order statistics, estimation of location and scale parameters, censoring, robust estimation, treatment of outliers, asymptotic distributions of quantiles, extremes, and linear functions of order statistics

647 Multivariate Analysis. (3-0) Cr 3 F *Prereq 543, Math 307* Han Multivariate normal distribution, Wishart distribution, multiple correlation, Hotelling's T^2, multivariate regression analysis, discriminant analysis, principal components, canonical correlations

648. Seminar on Theory of Statistics and Probability. Cr Var *Prereq 543*

651. Time Series. (Econ 651) (3-0) Cr 3 Alt S, offered 1982 *Prereq. 538*. Fuller, Goebel Covariance and spectral representation of time series. Stationary and nonstationary autoregressive models Fourier and periodogram analyses. Stochastic difference equations Estimation and distribution theory

661. Theory of Inference. (2-0) Cr 2 Alt SS, offered 1982 *Prereq 543* Kempthorne The historical development, significance testing, Neyman-Pearson theory, fiducial inference, types of probability, Ramsey, Jeffreys, Savage, Bayesian ideas, likelihood inference, theory of evidence, recent literature

680. Advanced Statistical Computing (3-0) Cr 3 S *Prereq 580* Kennedy Selected methods and algorithms in the areas of unconstrained and constrained nonlinear function optimization, robust estimation, and classical multivariate analysis Emphasis on the most recent advances in these and other areas supported by statistical computing

699. Research

Surveying

Administered by the Department of Civil Engineering

Rolland L Hardy, Professor in Charge

Professors: Hardy, Jeyapalan

Assistant Professors: Montag

Undergraduate Study

For undergraduate curriculum in surveying leading to the degree Bachelor of Science, see *College of Engineering, Curricula*

Surveying is a curriculum administered by the Department of Civil Engineering It is designed to provide a strong fundamental knowledge of engineering and areas of surveying specialization such as land surveying, engineering surveying, geodetic or control surveying, aerial surveying or photogrammetry, and cartographic surveying for original maps, charts, or other cartographic products Graduates of this curriculum may expect to be involved professionally in the planning, design, and responsible execution of surveying and mapping operations

Professional registration as a surveyor occupies a unique position among the several classifications licensed by state boards of engineering and surveying examiners Generally the professional surveyor is the only registered professional who can practice in the specialty of property (land) surveying Many registered surveyors form consulting firms and practice only in land surveying or in land surveying and other specialties of surveying Others become key professionals in consulting firms engaged in both civil engineering and surveying

Career opportunities also exist in industry and government Employment by industry frequently involves professional work with aerial surveying or photogrammetric engineering firms involved in map production Some such firms are also involved in research, development, design and testing of advanced geodetic and photogrammetric systems Federal, state, and local government activity includes national geodetic and mapping programs, public land surveys, natural resource exploration, modernization of land data systems, subdivision design review, and other administrative or legal control matters

A cooperative education program is available for students in surveying See *Cooperative Programs, College of Engineering*

For description of courses, see *Civil Engineering*

Graduate Study

Work for the Master of Science with a major in geodesy and photogrammetry is administered by the Department of Civil Engineering For description of courses, see *Civil Engineering*

Technology and Social Change

(Interdepartmental Minor)

Supervisory Committee: G W Beran, H C Chang, L Fletcher, K E Gwiasda, S Huang, E C Jones (Chair), J Knox, S Marley, P Morgan, J Murdock, M Rahman, C Roderuck, A A Smith, R Talbot, M Ulmer, R Van Iten (vice-chair), D M Warren, L Wilcox (vice-chair), R Wilham, W Wolansky

Undergraduate Study

Undergraduate study in this program provides the student with an opportunity to develop a minor or an area of concentration in technology and social change It involves a balanced grouping of courses in technology, the social sciences, and the humanities with specialized courses in the area, helping the student to develop both a sensitivity to the issues and the ability to synthesize ideas from the variety of disciplines important to the technology and social change process It also serves as preparation for advanced study in this area A specific program should be developed for each student, and should involve a member of the technology and social change committee from outside the student's curriculum as well as the student's adviser The committee maintains a list of recommended courses, revising it annually

Students pursuing a baccalaureate degree program may elect a minor in technology and social change if the college in which they are enrolled permits declared minors The minor requirement includes approximately 14 credit hours, including 4 credits of technology and social change courses, to be chosen outside the student's major from a list approved by the technology and social change advisory committee The courses chosen should complement the major so that a balance of humanities, social sciences, and technology courses is achieved The minor program is selected in consultation with a member of the technology and social change committee and the student's adviser

Students enrolled in colleges that do not have declared minors may plan the social science-humanities part of their degree program to achieve a concentration in courses related to technology and social change in consultation with a member of the technology and social change advisory committee and the student's adviser

Graduate Study

Work is offered for a minor in technology and social change under a cooperative arrangement with the following departments participating in the program Aerospace Engineering, Agricultural Engineering, Agronomy, Animal Science, Architecture, Chemical Engineering, Chemistry, Civil Engineering, Community and Regional Planning, Computer Science, Earth Sciences, Economics, Electrical Engineering,

English, Family Environment, Food and Nutrition, History, Industrial Education, Industrial Engineering, Journalism and Mass Communication, Materials Science and Engineering, Mechanical Engineering, Nuclear Engineering, Philosophy, Physics, Political Science, Professional Studies in Education, Sociology and Anthropology, and Textiles and Clothing

Students choosing to declare a minor in technology and social change will pursue a degree program in the major department A member of the supervisory committee of the interdepartmental program technology and social change will serve on the committee guiding the student's program of study This member should be a member of the graduate faculty, and should be from a discipline outside the field of the major area of study He or she is to be chosen by the student in consultation with the chairman of the supervisory committee, and appointed by the dean of the Graduate College

The committee guiding the program of study of a student declaring a minor in technology and social change will select a group of courses from the list given below For the master of science degree, this group should be at least 10 credit hours and for the doctor of philosophy degree the minimum requirement is 15 hours Of this requirement, 4 hours must be chosen from courses in technology and social change acceptable for graduate credit

The group of courses selected by the student's committee to form a minor in technology and social change must be chosen from outside the major area of study They should be designed to broaden the scope of the student's training to include the humanities, the social sciences, and technology The program for the declared minor will be approved by the technology and social change supervisory committee

A minor in technology and social change should be selected from the following suggested courses

Technology and Social Change 541, 542, 590F, 640
Aerospace Engineering 350, 481, 485, 571, 575
Agricultural Engineering 422, 430, 435, 471, 501
Agronomy All courses appearing in graduate catalog are acceptable
Animal Science: All courses appearing in graduate catalog are acceptable
Anthropology. 533, 560D, 560E, 560G
Architecture 311, 312, 372, 373, 473, 521G, 544I, 572, 577
Chemistry 331, 332, 426, 599
Community and Regional Planning 380, 383, 395, 405, 493, 511, 515, 520, 527, 575
Computer Engineering 340, 440
Computer Science 375, 441
Economics. 411, 512, 520, 535, 561
Electrical Engineering· 450, 451, 474, 476
English 495, 534
Family Environment. 391, 510, 519, 521, 522, 575, 604
Food and Nutrition 305, 319, 410, 413, 414
Geography: 495
Geology· 484
History 436, 458, 459, 463, 480, 481, 482, 489, 591C, 592
Industrial Education. 502, 554, 615, 644, 652, 657
Industrial Engineering. 404, 424, 425, 475, 504, 505, 511, 515, 527, 552, 624
Journalism and Mass Communication. 425, 515, 545, 590G, 590I, 590K
Materials Science and Engineering All courses appearing in graduate catalog are acceptable
Meteorology 406, 531
Nuclear Engineering 401, 484, 541, 654
Philosophy 380, 431, 480
Physics 304, 311, 311T, 350, 361, 364, 365, 447, 511, 524, 528, 531, 571, 572
Political Science 443, 444, 447, 448, 481, 543, 547, 549, 578
Professional Studies in Education HPC Ed 581, 584, 585, 586, 590
Sociology 331, 411, 415, 420, 445, 450, 464, 532, 533, 540, 550, 566, 575, 642
Textiles and Clothing 354, 355, 404, 465, 525, 554, 555, 565, 580

Courses Primarily for Undergraduate Students

341. Technology: International, Social, and Human Problems. (U St 341) (3-0) Cr 3 F An interdisciplinary study of the international significance of technology and of the societal and human issues attending its development and adoption

440 Seminar in Technology and Social Change: The International Dimension (U St 440) (1-0) Cr 1 each time elected S *Prereq. 341* International problems involved in the transfer of technology and resultant social change in foreign cultures

490F. Special Topics: Technology and Social Change. (U St 490F) Cr var F S SS *Prereq 341* Consideration of problems and issues arising from the impact of the transfer of technology on a society

Courses Primarily for Graduate Students, minor only, open to qualified undergraduates.

541 Technology and Social Change in Foreign Cultures (U St 541) (3-0) Cr 3 F *Prereq Senior or graduate classification* An interdisciplinary study of technology and the effects of technological change within economically less developed countries Analysis of the role of science and technology in development, implications and consequences of technology transfer, issues and constraints involved in choosing an appropriate technology

542 World Food Issues (U St 542) (3-0) Cr 3 S *Prereq 541 or graduate classification* An interdisciplinary study of societal, human and technological aspects of the world food situation The study examines four issues the present world food situation, the challenge of meeting future food requirements, constraints to growth and change, and professional, scientific, and technical strategies for development

590F. Special Topics Technology and Social Change (U St 590F) Cr var F S SS *Prereq 541* Individual study on topics involving technology and social change in foreign cultures

Course for Graduate Students, minor only

640. Seminar in Technology and Social change (U St 640) Cr 1-3 each time elected S SS *Prereq 541* Consideration of problems and issues arising from the effects of technological change in foreign cultures Issues and problems vary each time offered

Telecommunicative Arts

For description of courses, see *Speech*

Textiles and Clothing

Agatha L Huepenbecker, Head of Department

Professors: Danielson, Huepenbecker, Winakor

Professors Emeritus: Hollen, Potgieter, Saddler, Warning

Associate Professors: Farrell, Hall, Kundel

Assistant Professors: Brackelsberg, Kadolph, Kim, Kunz, Langford, Littrell, Marshall, Polan, Reilly, Seifert, Shibles, Stone, Williams

Instructors: Jezek, Rice

Undergraduate Study

The department offers work for the degree Bachelor of Science with curricula in apparel design and patternmaking, fashion merchandising, and textiles and clothing related science The latter curriculum has two options physical science and social science These curricula prepare graduates for a wide variety of careers in business, industry, and government

The curriculum in apparel design and patternmaking is planned for those interested in the aesthetic aspects of textiles and clothing and in apparel designing The program in fashion merchandising is planned for students interested in careers in the marketing of textiles and clothing products by retailers and manufacturers, within the framework of sound business management

The curriculum in textiles and clothing related science is designed for those who wish to prepare for advanced study leading to careers in college teaching or in research The physical science option prepares the student for research in textiles and forms a foundation for further study The social science option is designed for the student interested in the historic, economic, sociological, or psychological aspects of clothing and textiles

Courses in textiles and clothing provide knowledge applicable to the use of clothing and household fabrics by individuals and families The scientific and cultural aspects of textiles and clothing are examined, with emphasis on aesthetic, economic, sociological, anthropological, and psychological aspects

Graduate Study

The department offers the degree Master of Science with a major in textiles and clothing, and a minor to students taking major work in other departments The department participates in the interdapartmental minor programs of Gerontology and Technology and Social Change (see Index)

Prerequisite to major graduate work is the completion of selected courses in art and design, the humanities, physical and social sciences, and textiles and clothing The specific prerequisites will depend upon the nature of the work the student wishes to pursue A thesis is required

Open to graduate students for minor credit only 354, 355, 404, 464, 465, 468

Courses Primarily for Undergraduate Students

121 Clothing Construction. (1-5) Cr 3 F S Principles of clothing construction, use of commercial patterns, from a consumer's standpoint, the study of factors influencing quality of custom-made garments and those that are commercially produced

165. Clothing in Contemporary Society. (2-0) Cr 2 F S An interdisciplinary approach to the significance of clothing to individuals and families within contemporary western society; study of diverse clothing needs

204. Introduction to Textiles. (3-3) Cr 4 F S Introduction to textile fibers, yarns, fabric construction, and finishes related to consumer use, serviceability concepts and quality evaluation of apparel fabrics and household textiles

221. Fitting and Flat Pattern. (1-3) Cr 2 F S *Prereq. 121. Closed to design majors.* Basics of flat pattern designing as it pertains to fitting, alteration of manufactured garments Credit in both 221 and 222 cannot be used toward graduation

222. Flat Pattern Designing. (1-5) Cr 3 F S. *Prereq 121, 245* Flat pattern designing and related garment construction for men and women, making patterns for and constructing selected designs in appropriate fabrics. Credit in both 221 and 222 cannot be used toward graduation

245. Clothing Selection. (2-2) Cr 3 F S *Prereq Art 102* Use of line, color, and texture to create specific effects in apparel design and to achieve certain personal appearance goals Analysis of the creative style of various couture and ready-to-wear fashion designers Study of consumer choices of quality clothing

275. Fashion Industries. (3-0) Cr 3 F S History, organization, operation, and merchandising activities of the manufacturing sector of the fashion industry Professional opportunities are explored

278, 279. Fashion Illustration. (Art 278, 279) See *Art and Design*

304. Textile Testing. (0-6) Cr 2 F S *Prereq. 204, Chem 163, 163L.* Planning, executing, and reporting of textile laboratory testing to determine the quality of textile materials.

323. Draping. (1-5) Cr 3. F S *Prereq. 245, 221 or 222* Pattern-making by draping on a standard body form, emphasis on designing, fitting, construction

329. Tailoring. (1-5) Cr 3 F S *Prereq: 121, junior classification* Custom tailoring techniques applied in making suits and coats, alternate techniques as applied to tailored garments for men, women, and children Fee

345. Fashion Design. (1-5) Cr 3 F S *Prereq 245, 278* Creative problems integrating sources of inspiration, procedures, and presentation techniques used in designing apparel Analysis of contemporary designers and trends

354. History of Costume I. (3-0) Cr 3 F S , alt SS , offered 1983. *Prereq. Hist 201 or Art 280* Clothing styles of men, women, and children in western civilization from prehistoric times to present, factors associated with origin, adoption, and abandonment of styles.

355. History of Textiles I. (3-0) Cr 3. F S., alt SS , offered 1982 *Prereq 204, Hist 201 or Art 280* Aesthetic development of world textiles including historic and traditional textiles Textiles for costume and for enrichment of architectural interiors Societal factors influencing design and production of ornamental textiles

375. Merchandising I. (3-0) Cr 3 F S *Prereq Junior classification* Principles of merchandising as applied to textiles and apparel in retail organizations. Study of customer demand, buying, inventory, control, and promotion Orientation to field experience and careers in retail merchandising

376. Merchandising II. (2-0) Cr 2 F.S *Prereq 375.* Theories and procedures relating to purchasing, planning and inventory control techniques in the profitable operation of a fashion department or store

404. Advanced Textiles. (3-0) Cr 3 F S *Prereq 204* Fabric properties as determined by fiber structure and composition, fabric formation, finishes Emphasis on new developments.

431. Intermediate Fashion Design. (1-5) Cr 3 F *Prereq 222, 323, 345* Original fashion designs for ready-to-wear and custom clothing, sketches, patterns, and finished garments. Emphasis on current fashion trends and comparison of custom and ready-to-wear construction techniques Field trip Fee

464. Family Clothing Consumption. (3-0) Cr 3. F S , alt SS , offered 1982 *Prereq: Econ 201, junior classification.* Theories of clothing consumption, factors affecting family expenditures for clothing and household textiles, study of standard budgets.

465. Sociological and Psychological Aspects of Clothing and Textiles I. (3-0) Cr 3 F S., alt SS, offered 1983 *Prereq 165, Psych 101, Soc 134* Functions and meanings of dress in contemporary societies and subcultures. A social science research emphasis

468. Clothing for Special Needs. (3-0) Cr 3 F *Prereq 221 or 222, 165 or F E 360* Analysis of clothing problems as related to physical, social, and psychological well-being of people with special needs Selection and design of functional clothing to meet the specific requirements of children, the elderly, or individuals who may be physically or mentally handicapped

470. Supervised Experience. Cr 2 to 6 F SS *Prereq Permission by application* Supervised work experience in a cooperating retail firm, design studio, museum, or in extension

A Textile Industry *Prereq 304*
B Historic Textiles and Clothing *Prereq. 6 credits from 354, 355, 490B, 490E, 3 credits in anthropology strongly recommended*
D Fashion Design and Manufacture *Prereq. Junior or senior classification, 345, at least 9 credits in pattemmaking and construction*
I Fashion Merchandising *Prereq 375*
J Extension *Prereq 6 credits in textiles and clothing*

475. Merchandising III. (3-0) Cr 3 F *Prereq 470I, permission of instructor* Analysis of typical merchandising problems through the decision-making process, case study method, against a basic background of human relations in management

480. Study Tour. Cr R F S *Prereq 9 credits in textiles and clothing, junior classification* Study of and tours to fabric mills, apparel producers, designers, trade marts, retail firms, museums, fabric mills, testing laboratories and other areas of interest in clothing and household textiles

490. Independent Study. Cr 1 to 2 per semester *Prereq 6 credits in Textiles and clothing, permission of the department head and instructor*

A Textiles
B History of Textiles
C Clothing Construction and Pattemmaking
D Fashion Design
E History of Costume
F Sociological and Psychological Aspects of Clothing and Textiles
G Economic Aspects of Clothing and Textiles
H Honors
I Fashion Merchandising

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

500. Short Course. Cr arr SS

A. Textiles
B History of Textiles
C Clothing Construction and Pattemmaking
D Fashion Design
E History of Costume
F Sociological and Psychological Aspects of Clothing and Textiles
G. Economic Aspects of Clothing and Textiles
I Fashion Merchandising

504. Textile Science. (3-0) Cr 3 F *Prereq. 404* Scientific principles and theories involved in fiber formation, fiber and fabric structures, color, and finishes, analysis of fabric geometry and deformation

521. Experimental Clothing Construction. (2-3) Cr 3 F *Prereq 6 credits in clothing construction/pattemmaking* Problem solving approach to clothing construction and fitting Use of different fabrics, time studies and alternative techniques

525. Advanced Pattemmaking. (1-5) Cr 3 S. *Prereq. 345, 6 credits in pattemmaking* Use of flat pattern and draping techniques for more intricate designs of sleeves, bodices, dresses Methods of drafting basic pattern blocks and pattern grading procedures. Pattemmaking for unlined coat or jacket, for men's wear and or children's wear

545. Advanced Costume Design. (2-0) Cr 2 S *Prereq: 6 credits from 345, Phil 340, Psych 312* Analysis of costume in the light of theories formulated by writers on aesthetics, art history, costume history, and perception.

554. History of Costume II. (2-0) Cr 2 F *Prereq. 354.* Study of garments in the historic collection and their relationship to other sources of information, research techniques, individual study of selected periods

555. History of Textiles II. (2-0) Cr 2 S *Prereq 355* Technical aspects of fabric structure and applied textile design within and across cultures, evolution of classic and individual textile motives, research techniques, individual topics.

557. Restoration and Conservation of Textiles. (1-2) Cr 2 Alt. F , offered 1982 *Prereq 304, 354 or 355* Purpose and function of historic collections, problems in acquisition and cataloging, restoration, and preservation techniques for maintenance, storage, and display of historic textiles and costumes

565. Sociological and Psychological Aspects of Clothing and Textiles II. (2-0) Cr 2 F *Prereq 465* Readings in sociological and psychological literature applicable to clothing and textiles. Written and oral presentations of reading and research Emphasis on theory

580. International Study Tour. Cr 1 to 5 Every third SS offered 1983 *Prereq 354, 355* A short period of orientation (lectures, film, discussion, short field trips and study) before travel to observe garments and textiles in mills, factories, homes, stores, laboratories and museums Countries studied and visited will vary

590. Special Topics. Prereq Permission of department head and instructor(s) concerned Cr arr

A. Textiles
B History of Textiles
C Clothing Construction and Pattemmaking
D Fashion Design
E History of Costume
F Sociological and Psychological Aspects of Clothing and Textiles
G Economic Aspects of Clothing and Textiles

Courses for Graduate Students, major or minor

610. Seminar. Cr 1 S

656. Asian Costume and Textiles. (2-0) Cr 2 Alt S offered 1982 *Prereq 555, Asian history or Asian art history* Group and individual studies of traditional costume and textiles of selected Asian countries Includes China, Japan, Korea, Southeast Asia, India, Indonesia and selected Middle Eastern countries Topics may vary with semester of offering

657. Ethnic or Regional Costume and Textiles (2-0) Cr 2 Alt S., offered 1983 *Prereq. 555* Group and individual studies of traditional costumes and textiles of selected folk cultures Includes cultures of Europe, the Americas, Africa, and Oceania Topics may vary with the semester of offering

699. Research.

Transportation Planning

(Interdepartmental Major)

Robert L. Carstens, Chair, Supervisory Committee

Supervisory Committee: C. P. Baumel, K A Brewer, M R. Hill, H. D. Meeks, D. B. Vellenga, R I Wessel, W. F. Woodman

Work is offered for degree Master of Science (thesis and non-thesis options) with major in transportation planning under a cooperative arrangement with various departments including Civil Engineering, Community and Regional Planning, Economics, and the School of Business Administration, Industrial Engineering, Political Science, and Sociology Opportunities are afforded for research in such areas as modeling and performance of transportation systems, techniques for urban and regional transportation system planning, environmental and social policy analysis of transportation

systems, transportation policy analysis, anaylsis of transportation technologies, commodity distribution, public administration of the transportation planning process, regional development and transportation system interrelationships, transportation economics and finance, and planning for logistics management

Students majoring in transportation planning will choose a major professor from the graduate faculty membership of the cooperating departments and will develop a program of study under the guidance of a committee nominated by the administrative department head, approved by the departmental transportation planning supervisory committee representative, and appointed by the dean of the Graduate College For administrative purposes, students will be in the departments of their major professors

A student must complete at least 30 credit hours of acceptable work At least 20 credits for the thesis option and 24 credits for the non-thesis option shall be selected from a list of courses approved for inclusion in a program in transportation planning The foreign language requirement, if any, is established on an individual basis by the student's program of study committee

Courses Primarily for Graduate Students, major only

690 Advanced Topics Cr 1 to 2 Creative component for non-thesis Master of Science degree

691 Seminar in Transportation Planning. (1-0) Cr 1 each time taken F S

699 Research

University Studies

George C Christensen, Vice President for Academic Affairs

Certain interdisciplinary courses are offered through University Studies, at the discretion of the Vice President for Academic Affairs and the University Curriculum Committee No major is available in University Studies, but credit obtained through University Studies offerings may be applied toward a degree in any of the colleges, consistent with the stipulations of the student's curriculum

Requests to make use of University Studies 101, 290, 301, and 490 should be directed to the Vice President for Academic Affairs and should be accompanied by a positive recommendation from the department heads and deans of the instructors making the request The University Curriculum Committee will consider all requests and recommend to the Vice President regarding their disposition after consultation with relevant college and University committees

Open to graduate students for minor credit only 421, 425

Courses Primarily for Undergraduate Students

101 Interdisciplinary Studies. Cr var Yr Offered when demand warrants Experimental interdisciplinary courses offered by an interdepartmental group Intended primarily for freshman and sophomore offerings

121H. Freshman Honors Seminar. (2-0) Cr 1 Orientation to Iowa State University and to the University Honors Program For members of the Freshman Honors Program only

221 Introduction to Environmental Studies. (Env S 221) (3-0) Cr 3 F *Prereq Sophomore classification* The structure and dynamics of environmental systems, social and ecological Basic ecology, the role of information, material resource availability and use, energy resource availability and use, and pollution of air, water and land

222. Introduction to Environmental Studies. (Env S 222) (3-0) Cr 3 S *Prereq Sophomore classification* Human population structure and growth, the world food problem, production and consumption patterns in ecosystems and social systems, cultural approaches to the environment, and the growth vs no growth controversy Emphasis on factors affecting decision making

225 Introduction to Environmental Education (Env S 225) (2-2) Cr 3 F Goals, issues, and instructional materials in environmental education Field experience with teachers and children Environmental education as a multidisciplinary endeavor Environmental education in non-school agencies Contemporary environmental education compared with outdoor education, nature study, and conservation education

230. Seminar in International Studies. (2-0) Cr 1 S Introduction to international studies Required of all students in the International Studies Program

241 Introduction to World Food Problems. (Agron 241) (2-0) Cr 2 F An interdisciplinary approach to the principal world food problems and their interrelations Emphasis on population, nutrition, energy, food production, social and economic policy, and infrastructure problems

290. Special Problems. Cr var *Prereq Permission of the Vice President for Academic Affairs* Independent study on topics of an interdisciplinary nature Intended primarily for freshmen and sophomores
E Environmental Studies (Env S 290E)
H Honors

301. Interdisciplinary Studies. Cr var Yr Offered when demand warrants Experimental interdisciplinary courses offered by an interdepartmental group Intended primarily for junior and senior offerings

311, 312, Seminar 81, 82. (1-0) Cr 1 Multidisciplinary seminars focusing on issues of current interest Leaders from university faculty, community, business, industry Emphasis on student-faculty inquiry with opportunity for discussion Offered on a satisfactory-fail basis only Offered when demand warrants

321, 322 University Honors Seminars (2-0) Cr 1 or 2 Yr *Prereq Membership in the University Honors Program* Interdisciplinary seminars on topics to be announced in advance Offered on a satisfactory-fail basis only

341. Technology: International, Social, and Human Problems. (TSC 341) (3-0) Cr 3 F An interdisciplinary study of the international significance of technology and of the societal and human issues attending its development and adoption

391 Seminar in Environmental Studies (Env S 391) (1-0) Cr 1 F S *Prereq Junior classification* Seminar discussions of various topics of environmental concern

421 Policies and Procedures in Environmental Analysis (Env S 421) (2-2) Cr 3 F *Prereq 221, 222* History of environmental legislation and the development of environmental assessment Interrelationships among federal, state, and local agencies the public and the courts in implementing environmental laws and regulations Techniques for the analysis and preparation of environmental impact statements under the National Environmental Policy Act Field trips

425. Environment and Society (Env S 425) (3-0) Cr 3 SS *Prereq 10 hours in social or natural sciences* An in-depth analysis of natural and human-modified ecosystems with attention on energy, resources, food and population as they relate to society and the quality of human environments

430 Seminar in International Studies. (3-0) Cr 3 F Capstone seminar required of majors in international studies For juniors and seniors only

437. Foreign Study Cr var F S SS *Prereq Permission of chairman of the International Studies Committee* Individual and group study in foreign countries Intended primarily for juniors and seniors

440. Seminar in Technology and Social Change: The International Dimension. (TSC 440) (1-0) Cr 1 each time elected S *Prereq 341* International problems involved in the transfer of technology and resultant social change in foreign cultures.

490 Independent Study. Cr var *Prereq Permission of the Vice President for Academic Affairs* Independent study on topics of an interdisciplinary nature Intended primarily for juniors and seniors
E Environmental Studies (Env S 490E)
F Technology and Social Change (TSC 490F)
H Honors
I International Studies

Courses Primarily for Graduate Students, open to qualified undergraduates.

541 Technology and Social Change in Foreign Cultures. (TSC 541) (3-0) Cr 3 F *Prereq Senior or graduate classification* An interdisciplinary study of technology and the effects of technological change within economically less developed countries Analysis of the role of science and technology in development, implications and consequences of technology transfer, issues and constraints involved in choosing an appropriate technology

542. World Food Issues. (TSC 542) (3-0) Cr 3 S *Prereq 541 or graduate classification* An interdisciplinary study of societal, human and technological aspects of the world food situation The study examines four issues the present world food situation, the challenge of meeting future food requirements, constraints to growth and change, and professional, scientific, and technical strategies for development

590 Special Topics. Independent study on topics of an interdisciplinary nature Intended primarily for graduate students
F Technology and Social Change (TSC 590F)

Course for Graduate Students, minor only

640 Seminar in Technology and Social Change. (TSC 640) Cr 1-3 each time elected S SS *Prereq 541* Consideration of problems and issues arising from the effects of technological change in foreign cultures Issues and problems vary each time offered

Veterinary Anatomy

J Carithers, Chair of Department

Professors: J Carithers, Cholvin, Christensen, Dellmann, Ghoshal

Emeritus Professor: Magilton

Associate Professors. Adams, Bal, Draper, Uemura

Instructors: Forsythe, Jacobson

Undergraduate Study

Through courses in this department, students acquire a detailed knowledge of the anatomy of domestic animals which is necessary for a proper understanding of physiology, pharmacology, pathology, diagnosis, surgery, and medicine

For the undergraduate curriculum leading to the degree Doctor of Veterinary Medicine, see *Veterinary Medicine, Curriculum*

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with a major in veterinary anatomy, and minor work for students majoring in other departments

Cooperative programs between Veterinary Anatomy and the Biomedical Engineering Program are provided jointly under sponsorship

by the colleges of Engineering and Veterinary Medicine. See *Biomedical Engineering* for requirements. The department also participates in the interdepartmental program in Molecular, Cellular and Developmental Biology

Fundamental knowledge of anatomy, biochemistry, chemistry, mathematics, physiology, and zoology is considered prerequisite for major study in the department.

Foreign language requirements may be established by the student's graduate advisory committee.

Courses Primarily for Undergraduate Students

301. Morphology of Domestic Animals. (4-15) Cr 9 *Prereq: First year classification in Veterinary Medicine* Developmental, gross, and microscopic anatomy of carnivores

302. Morphology of Domestic Animals. (3-9) Cr 6 *Prereq. 301.* Developmental, gross, and microscopic anatomy primarily of ungulates

303. Applied Anatomy. (0-6) Cr. 2. S. *Prereq: 302.* Study of anatomy of domestic animals as related to diagnostic, surgical and radiographic techniques

490. Independent Study. Cr Arr *Prereq: Permission of Instructor*
H Honors

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

509. Systematic Anatomy (1-3 or 2-6) Cr 2 or 4 SS *Prereq. One year of college biology, permission of instructor* For non-anatomy majors
A. Ruminant Anatomy Cr 4
B Nonruminant Anatomy Cr 4
C Avian Anatomy Cr 2

511. Neuroanatomy. (2-4) Cr 4 Alt F, offered 1982 *Prereq. 10 credits in biological science, permission of the instructor* Gross and microscopic anatomy of the central nervous system including the organs of special sense

515. Anatomy of Laboratory Animals. (2-3) Cr 3 Alt S, offered 1982 *Prereq One year of college biology* Gross anatomy and histology of laboratory animals

520. Structure and Fine Structure of Animal Tissues and Organs. (3-6) Cr 6. Alt S., offered 1982 *Prereq: 10 credits in biological science, permission of the instructor* Study of the morphology of cells, tissues, and organs of domestic animals at the light and electron microscopic level

521. Advanced Gross Anatomy. (2-9) Cr 5 S *Prereq Bachelor's degree in a biological science and permission of instructor* Systematic and topographic study and dissection of the horse, ruminant, and pig

590. Special Topics. Cr 1-5
A Gross Anatomy
B Microscopic Anatomy
C Developmental Anatomy
D Neuroanatomy

Courses for Graduate Students, major or minor

690. Advanced Topics. Cr 1-3.
A. Gross Anatomy
B Microscopic Anatomy
C Developmental Anatomy
D Neuroanatomy

698. Seminar. Cr 1

699. Research.
A. Gross Anatomy
B Microscopic Anatomy
C. Developmental Anatomy
D Neuroanatomy

Veterinary Clinical Sciences

Wallace M Wass, Head of Department

Professors: Baker, R. Carithers, Clark, Evans, Grier, Herrick, Hoefle, Kunesh, Lundvall, Pearson, Wass

Emeritus Professors: Emmerson, Preston

Associate Professors: Appell, Betts, Chastain, Eness, Jackson, Mitten, Riedesel

Assistant Professors: Egger, Hill, McNeel, Merkley, Owen, Reinertson, Thompson, Wilson, Zenoble

Instructors: Griffith, J Lofstedt, R Lofstedt, McKenna, Nichols, Rigg, Runyon

Undergraduate Study

For undergraduate curriculum in veterinary medicine leading to the degree Doctor of Veterinary Medicine, see *Veterinary Medicine, Curriculum.*

The study of medicine and surgery expands the training previously received in anatomy, physiology, pharmacology, pathology, and microbiology

The department presents course work in animal reproduction concerning interferences with parturition, diseases of the newborn, and infertility

The teaching of radiology emphasizes the handling, exposing, processing, and interpreting of radiographs and the dangers of ionizing radiation to man and animal

Hospital assignments during the fourth year provide the student an opportunity to participate in the application of clinical skills and knowledge

Graduate Study

The department offers work for the degree master of science with major in veterinary clinical science, and minor work for students majoring in other departments Within the veterinary clinical sciences major, the student may specialize in veterinary medicine, surgery, radiology, or theriogenology

Both thesis and nonthesis options are available

A satisfactory reading knowledge of one foreign language is strongly recommended The department uses the standardized examinations provided by Educational Testing Service for this purpose However, the department will accept meaningful collateral work in lieu of a foreign language if this is recommended by the student's program of study committee

Prerequisite to major graduate work is graduation from an approved college of veterinary medicine.

Open to graduate students for minor credit only: 443.

Courses Primarily for Undergraduate Students

391. Radiology. (2-0) Cr 1 S. 8 weeks. *Prereq. Second year classification in veterinary medicine.* Essentials of radiology and radiobiology. Includes radiography, fluoroscopy, and clinical and biological uses of x-radiation and radioisotopes, with special emphasis on protection from radiation and interpretation of radiographs.

394. Clinical Medicine I. (4-0) Cr 4 S *Prereq Second-year classification in veterinary medicine* Clinial diagnostic methods and consideration of diseases of domestic animals.

397. Surgery and Anesthesiology. (4-0) Cr 4 S *Prereq Second-year classification in veterinary medicine* Principles of surgery and anesthesiology

440. Introduction to Clinics. Cr R 8 weeks *Prereq Third-year classification in veterinary medicine*

441. Special Surgery. (4-0) Cr 4 F. *Prereq Third-year classification in veterinary medicine* Surgical diseases of domestic animals

443. Large Animal Orthopedics. (2-0) Cr 2 S *Prereq Third-year classification in veterinary medicine* Orthopedic disesaes of large domestic animals

445. Clinical Medicine II. (3-0) Cr 3 F *Prereq Third-year classification in veterinary medicine* Clinical diagnosis and treatment of diseases of domestic animals

446. Clinical Medicine III. (3-0) Cr 3 S. *Prereq Third-year classification in veterinary medicine* Clinical diagnosis and treatment of diseases of domestic animals.

447. Animal Reproduction Laboratory. (0-4) Cr 1 F S 8 weeks. *Prereq: Third-year classification in veterinary medicine*

446. Radiology Laboratory. (0-4) Cr 1 F S 8 weeks *Prereq. Third-year classification in veterinary medicine*

449. Surgery Laboratory. (2-8) Cr 3 F S 8 weeks *Prereq Third-year classification in veterinary medicine*

450. Disturbances of Reproduction. (3-0) Cr 3 F *Prereq. Third-year classification in veterinary medicine* General principles of diseases causing disturbances in reproduction

460. Radiology. Cr 2 *Prereq Fourth-year classification in veterinary medicine* Clinical assignments in veterinary radiology Offered on a satisfactory-fail basis only

461. Animal Reproduction. Cr 2 *Prereq Fourth-year classification in veterinary medicine* Clinical assignments in animal reproduction Offered on a satifactory-fail basis only

462. Small Animal Medicine. Cr 4 *Prereq Fourth-year classification in veterinary medicine* Clinical assignments in small animal medicine Offered on a satisfactory-fail basis only

463. Small Animal Surgery. Cr 4 *Prereq Fourth-year classification in veterinary medicine* Clinical assignments in small animal surgery Offered on a satisfactory-fail basis only

464. Equine Medicine and Surgery. Cr 4 *Prereq Fourth-year classification in veterinary medicine* Clinical assignments in equine clinics Offered on a satisfactory-fail basis only

465. Veterinary Field Services. Cr 4 *Prereq Fourth-year classification in veterinary medicine* Clinical assignments in veterinary field services Offered on a satisfactory-fail basis only

466. Anesthesiology. Cr 2 *Prereq. Fourth-year classification in veterinary medicine* Clinical assignments in small animal and large animal anesthesiology. Offered on a satisfactory-fail basis only

467. Hospital Emergency Service. Cr R *Prereq Fourth-year classification in veterinary medicine* Clinical assignment to provide after hours supervision of hospital cases, including intensive care and emergency cases Offered on a satisfactory-fail basis only

490. Independent Study. Cr 1 to 5 *Prereq Permission of department head*

495. Seminar. Cr R. *Prereq. Fourth-year classification in veterinary medicine.* Seminars and case discussions on selected subjects by staff of the College of Veterinary Medicine and others, including student presentations Offered on a satisfactory-fail basis only

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

590. Special Topics. Cr 1 to 3. *Prereq Permission of instructor*
A. Medicine
B Surgery
C Theriogenology
D Radiology
E. Anesthesiology

604. Seminar Cr I F S

640 **Advanced Radiology.** (2-0) Cr 2 F *Prereq. 448* Detailed principles of clinical radiology with particular reference to radiographic interpretation

644 **Advanced Animal Reproduction.** (1-3) Cr 2 Alt S, offered 1982 *Prereq 447, 450* A detailed study of reproductive diseases of the male animal

645. **Advanced Animal Reproduction.** (1-3) Cr 2 Alt S, offered 1983 *Prereq 447, 450.* A detailed study of reproductive diseases of the female animal

671 **Advanced General Surgery.** (1-3) Cr 2 Alt S, offered 1982 *Prereq 441.* An advanced course designed to investigate and discuss the responses of the body to surgical and anesthetic procedures

672 **Advanced Special Surgery.** (1-3) Cr 2 Alt S, offered 1983 *Prereq 449* Advanced procedures in both clinical and research techniques in abdominal, thoracic orthopedic, cardiovascular, and neurological surgery

676 **Advanced Medicine.** (2-0) Cr 2 Alt F, offered 1981 *Prereq 446* Principles of general medicine A study in depth of factors that contribute to the development of clinical signs as related to the pathogenesis of disease

677 **Advanced Medicine.** (2-0) Cr 2. Alt F, offered 1982 *Prereq 446* An advanced study of metabolic diseases

678 **Laboratory Animal Medicine and Pathology.** (V Pth 678) (2-0) Cr 2 Alt SS, offered 1983 *Prereq. 446* Detailed principles of medicine and pathology of laboratory animals

699 **Research**
A Medicine
B Surgery
C Theriogenology
D Radiology
E Anesthesiology

Veterinary Medicine

Phillip T Pearson, Dean
Durwood L Baker, Associate Dean
William P Switzer, Associate Dean
Roger M Hogle, Assistant Dean
Ronald E Flatt, Coordinator of Laboratory Animal Resources

Courses listed below are offered to undergraduate students in the College of Veterinary Medicine.

300 **Professional Orientation.** (1-0) Cr R F *Prereq First year classification in veterinary curriculum*

490 **Independent Study.** Cr 1 to 3 *Prereq Classification in veterinary curriculum* Independent or small group study of a specific area for which no course is available in an existing department
H Honors

Veterinary Microbiology and Preventive Medicine

T T Kramer, Chair of Department

Professors: Beran, Gough, Harris, Hill, Hofstad, Hogle, Jensen, Kaeberle, Kramer, Mengeling, Nelson, O'Berry, Packer, Pier, Reed, Ross, Switzer, Thoen, VanDerMaaten, Woode

Associate Professors: Abou-Gabal, Hoffman, Platt

Assistant Professors: Rosenbusch, Shoeman, Will

Instructors: Davies, Egan, Griffith, Jorgenson, Roth, Schleifer

Undergraduate Study

For undergraduate curriculum in veterinary medicine leading to the degree Doctor of Veterinary Medicine, see *Veterinary Medicine, Curriculum*

The Department of Veterinary Microbiology and Preventive Medicine offers instruction in pathogenic bacteriology and mycology, animal virology, immunology, epidemiology, and public health Regulatory and preventive veterinary medical aspects of the infectious diseases of animals are emphasized in courses for the student in the veterinary curriculum Courses designed for students in agriculture deal with the principles of disease prevention in farm animals

Graduate Study

The department offers opportunities for the degree Master of Science with majors in veterinary microbiology and veterinary preventive medicine. The degree Doctor of Philosophy with major in veterinary microbiology can also be earned Courses are also offered to students doing major work in other departments

Candidates for departmental majors must possess the D V M degree or an undergraduate degree in biomedical sciences with emphasis in medical microbiology

The department strongly recommends that applicants take the Graduate Record Examination and will use GRE scores as an important element in the selection of graduate students The program of study for the Ph D degree must contain a foreign language requirement or a significant cultural component in a collateral field of study The foreign language option can be satisfied by one year of college level courses in a foreign language (grade A or B) or a passing score on the ETS graduate student foreign language examination, or a test of scientific reading competence, administered by the department The alternative cultural component may be in the general areas of language and communication, philosophy and the scientific method, logic, history of science and culture, human values, etc The foreign language or cultural component requirement will be specifically determined by the student's program of study committee, with approval of the chair of department For students whose native language is not English, the ability to communicate adequately (as certified by the Department of English) will be required during the first year of study

The department also participates in the interdepartmental programs of Immunobiology and Molecular, Cellular and Developmental Biology (See Index)

Courses Primarily for Undergraduate Students

381. **Pathogenic Bacteriology and Immunology.** (4-6) Cr 6 S *Prereq First year classification in veterinary medicine.* Detailed study of bacteria associated with animal disease principles of immunology: mechanisms of infection

382. **Animal Virology and Mycology.** (3-0) Cr 3 F *Prereq: 381.* Characteristics of viruses and fungi which infect animals: mechanisms of infection and techniques used in their isolation and identification

384. **Public Health.** (3-0) Cr 3 S *Prereq. Second year classification in veterinary medicine* Principles of epidemiology; zoonotic diseases, inspection of food products of animal origin, water safety and animal waste handling

431. **Infectious Diseases and Preventive Medicine.** (5-0) Cr 5 S *Prereq Third year classification in veterinary medicine* History, etiology, epidemiology, laboratory diagnosis, regulatory control and preventive medicine aspects of the infectious diseases of animals

485. **Laboratory in Clinical Microbiology.** Cr 1 *Prereq Fourth year classification in veterinary medicine* Application of microbiological and immunological procedures to the diagnosis of infectious and immunologically mediated diseases.

486. **Laboratory in Public Health** Cr 1 *Prereq Fourth year classification in veterinary medicine* Laboratory exercises and field trips related to veterinary public health practices

487 **Livestock Disease Prevention** (3-0) Cr 3 S *Prereq Micro 300* A survey of diseases of large domestic animals, including discussion of causes, trasmission and control Designed for students majoring in agricultural sciences

489. **Principles of Immunology** (Imbio 489) (2-0) Cr 2 F *Prereq B B 301, Zool 206, 206L* Study of immunologic reactivity in animals and man inlcuding ontogeny, phylogeny, cell associations, mechanisms and functions of the immunologic system Consideration of immunobiology to health, disease and to other sciences

490. **Independent Study.** Cr Arr *Prereq Permission of instructor and department chairman*

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

520. **Medical Immunology I.** (Bact 520) (Imbio 520) (2-0) Cr 2 F *Prereq 381 or Micro 300* Kaeberle The immune response, antigens, antibodies, antigen-antibody interactions and other effector mechanisms of resistance to disease

520L. **Medical Immunology Laboratory** (Imbio 520L) (0-6) Cr 2 F *Prereq Credit or classification in 520* Kaeberle Principles of serology and detection of immunologic reactivity as applied to diagnosis of disease and research in immunology

522. **Principles of Epidemiology** (3-0) Cr 3 F *Prereq 381 or Micro 310* Disease transmission in animal and human populations Epidemic investigations Vital statistics and disease reporting

524. **Veterinary Medical Mycology.** (Micro 524) (2-6) Cr 4 *Prereq 382 or Bot 596, permission of instructor* Gabal Fungi pathogenic for animals and the diseases with which they are associated Methods of isolation and identification

526. **Advanced Veterinary Virology.** (Micro 526) (2-6) Cr 4 F, offered 1982 *Prereq 382 or Micro 408, permission of instructor* Pathogenesis and ecology of viral infections and the procedures for diagnosis and control of viral diseases

590 **Special Topics.** Cr 1 to 3 *Prereq 382*

Courses for Graduate Students, major or minor

604. **Seminar.** (1-0) Cr 1 F S Packer

625. **Pathogenic Bacteriology.** (2-6) Cr 4 S *Prereq 381* Packer, Thoen Advanced study of the pathogenic bactena and technical procedures used in research

626. **Basic Mechanisms in Animal Virology** (2-6) Cr 4 Alt F, offered 1981 *Prereq 526 or Micro 408, permission of instructor* Advanced study of animal virus host-cell interactions and technical procedures utilized in animal virus research

629. **Medical Immunology II.** (Imbio 629) (4-0) Cr 4 S *Prereq 520, 6 credits in biochemistry, permission of instructor* Kaeberle Role of immunologic mechanisms in health and disease The immunologic system, the immune response, biologic amplification, and factors regulating immunologic processes

631. **Immunologic Disease.** (V Pth 631) (Imbio 631) (2-0) Cr 2 Alt SS, offered 1982 *Prereq 629 and V Pth 653* Kaeberle, Kluge, Cheville Known and theoretical bases for immunologic diseases including mechanisms and physiopathologic alterations associated with disease processes

699 **Research.**

Veterinary Pathology

John P Kluge, Chair of Department

Professors: Andrews, Cheville, Flatt, Glock, D L. Graham, Green, Greve, Jeska, Kemp, Kluge, Ledet, Lloyd, Moon, Richter, Schwarte, Seaton, Zimmermann

Emeritus Professors: Lee, Ramsey

Associate Professors: Barnes, Carson, Cassidy, Daniels, Hagemoser, Holter, Larson, McKean, Niyo, O'Toole, Powers, M G I Riley, Stahr

Assistant Professors: C L Graham, D L Hopper, J H Riley

Instructors: Hall, J G Hopper, Hyde, Lomax, McAllister, Olson, Schmidt

Undergraduate Study

For undergradutae curriculum in veterinary medicine leading to the degree Doctor of Veterinary Medicine, see *Veterinary Medicine, Curriculum*

The Department of Veterinary Pathology offers a systematic study of the dynamics of the disease process Emphasis is placed on the manner in which disease brings about alterations in the anatomical structure and chemical and physiologic activities of animal cells, tissues, organs, and body systems The application of these studies forms the basis for more accurate diagnosis which is essential for the treatment and prevention of animal diseases

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with major in veterinary pathology, and minor work for students majoring in other departments Within the veterinary pathology major the student may specialize in veterinary parasitology or veterinary toxicology

Prerequisite to major graduate work is the completion of an undergraduate curriculum leading to the degree Doctor of Veterinary Medicine This requirement may be waived for those individuals wishing to specialize in toxicology or parasitology with the approval of the major professor and the chairman of the department

The degree Master of Science with thesis requires the completion of a minimum of 30 graduate credits It is possible to study for the degree Master of Sciehce on a nonthesis basis This option requires the completion of a minimum of 40 graduate credits, of which at least 10 must be eamed in course work outside the department.

The foreign language requirement will be decided by the student's program of study committee, with the approval of the chairman of the department For students whose native language is not English, the ability to communicate adequately in English (as certified by the Department of English) will be required

Minor work is recommended in other departments of the College of Veterinary Medicine or departments or programs in other colleges

The department also participates in the interdepartmental program of Immunobiology (See Index)

Courses Primarily for Undergraduate Students

371. General and Systemic Pathology. (4-3) Cr 5 F *Prereq Second-year classification in veterinary medicine* Basic concepts of cellular and tissue response to disease and tissue reaction to disease in the various body systems

376. Veterinary Parasitology. (4-3) Cr 5 F *Prereq Classification in 371* Parasitic diseases of domestic animals and their control

422 Special Pathology (3-3) Cr 4 S *Prereq 371* Pathogenesis of diseases in domestic animals

425 Clinical Pathology (1-4) Cr 3 F *Prereq 371* Principles of clinical hematology and clinical chemistry in domestic animals

426. Veterinary Toxicology (3-0) Cr 3 S *Prereq Third-year classification in veterinary medicine* A study of the disease processes in animals caused by toxicants, and of the use of differential diagnostic and therapeutic procedures

455. Diagnostic Laboratory. Cr 2 each time taken *Prereq Fourth-year classification in veterinary medicine* Practical experience in diagnosis of field cases Offered on a satisfactory-fail basis only

456. Necropsy Laboratory Cr 1 each time taken *Prereq Fourth-year classification in veterinary medicine* Practicum in post mortem examination and diagnosis

457 Clinical Pathology Cr 1 each time taken *Prereq Fourth-year classification in veterinary medicine* Methodology in clinical chemistry, hematology and cytology, practice in interpretation of laboratory data

490 Independent Study Cr arr *Prereq Permission of instructor and department chairman*
H Honors

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates.

551 (371 DL) General and Systemic Pathology (4-3) Cr 5 F *Prereq V An 301, 302, or Zool 322* Graduate study in conjunction with 371 Open only to students who do not have, or are not pursuing, the D V M degree Basic pathology with emphasis on disease in animals

554. (426 DL) Veterinary Toxicology (3-0) Cr 3 S *Prereq 371* Graduate study in conjunction with 426 Disease processes in animals caused by toxicants, differential diagnostic and therapeutic procedures

556. Methods in Toxicology (2-0) Cr 2 F *Prereq 10 credits in biology, permission of instructor* Application and interpretation of specific toxicology tests for the determination of harmful effects of poisonous substances

557 (376 DL) Veterinary Parasitology (5-3) Cr 6 F *Prereq 371 or 551* Graduate study offered in conjunction with 376 Open only to students who do not have, or are not pursuing, the D V M degree Parasitisms of veterinary importance, including the disease process and principles of control

560 Immunoparasitology (Zool 560, Imbio 560, Micro 560) (2-0) Cr 2 Alt S, offered 1982 *Prereq Courses in immunology and parasitology* Mechanisms of host-parasite relationships that affect the life cycle of the parasites Protozoa and helminths considered

590 Special Topics. Cr 1 to 3 F S SS *Prereq Permission of instructor*
A Veterinary Pathology
B Veterinary Parasitology
C Veterinary Toxicology
D Radiobiology

Courses for Graduate students, major or minor.

604. Histopathology Seminar Cr 1 F S SS

605. Topics Seminar Cr 1 F

631. Immunologic Disease. (Imbio 631) (V MPM 631) See *Veterinary Microbiology and Preventive Medicine*

641. Organic Pesticide Toxicology. (2-0) Cr 2 Alt F, offered 1983 *Prereq: 554, permission of instructor* Organic pesticides as related to biologic effects in animals of economic importance, public health hazards, and environmental effects

642. Toxicology of Heavy Metals and Trace Elements. (2-0) Cr 2. Alt. S, offered 1982 *Prereq 554, permission of instructor*. Advanced study of heavy metal pollutants and trace elements, their effects in domestic animals, wildlife, and man

643. Biotoxins. (3-0) Cr 3 Alt F, offered 1982 *Prereq 554, permission of instructor* Natural toxic background constituents in feeds, toxins present from management practices, pesticides of biological origin, and venoms

644. Feed Additives Toxicology (2-0) Cr 2 Alt S, offered 1983 *Prereq 554, permission of instructor* Toxicologic effects of feed additives and natural ingredients resulting from mismanagement or accident federal regulations

645. Analytical Chemical Toxicology. (1-3) Cr 2 F *Prereq: Chem 211, 322, permission of instructor* Analysis and interpretation of toxicant residues in animal tissues, feeds, water, soil, and other environmental specimens.

651. Advanced Post Mortem Techniques. (0-3 to 9) Cr 1 to 3 F S SS *Prereq 376, 422* Staff Necropsy techniques of animals with emphasis on gross and microscopic lesions and diagnosis

652. Pathologic Hematology. (2-2) Cr 3 Alt S, offered 1983 *Prereq 425* Pathologic changes in blood constituents of domestic animals

653. Cellular and Experimental Pathology. (3-6) Cr 5 Alt S, offered 1983 *Prereq 422, permission of instructor* Fundamentals of the pathogenesis of the disease process with emphasis on experimental pathology and disease models

654. Veterinary Neuropathology. (2-4) Cr 4 Alt F, offered 1982 *Prereq 551, 653* Advanced study of diseases of the nervous system

655. Physiopathology of the Skeletal System. (2-2) Cr 3 Alt SS, offered 1983 *Prereq 653* Graham Advanced study of the nutritional, metabolic, and infectious diseases of the skeletal system of domestic animals

656. Neoplasia and Granulomatous Diseases. (2-4) Cr 4 Alt F, offered 1983 *Prereq 376, 422* Advanced studies of granulomatous and neoplastic lesions of domestic animals

658. Histochemistry (1-2) Cr 2 Alt SS, offered 1983 *Prereq 422* Histochemical reactions in tissues useful in diagnosis of diseases of animals

660. Pathology of Parasitic Diseases. (2-3) Cr 3 Alt SS, offered 1982 *Prereq 371, 376* Gross and microscopic tissue changes caused by parasitic arthropods and helminths

661 Pathogenic Protozoa. (2-3) Cr 3 Alt F, offered 1983 *Prereq 371, 376* Major species of pathogenic protozoa pathogenesis, host response, and use as experimental subjects

663. Clinical Chemistry (2-2) Cr 3 Alt S, offered 1982 *Prereq 425* The pathophysiology, methodology, and clinical application of laboratory medicine

678. Laboratory Animal Medicine. (V C 678) See *Veterinary Clinical Sciences*

699. Research.
A Veterinary Pathology
B Veterinary Parasitology
C Toxicology

Veterinary Physiology and Pharmacology

Donald C Dyer, Chair of Department

Professors: Ahrens, Allison, Cholvin, Dougherty, Dyer, Engen, Hembrough, Littledike, Randic, Reece, Swenson, VanMeter, Whipp

Associate Professors: Argenzio, Crump, Draper, Greer, Martin, Pineda

Assistant Professor: Hsu

Undergraduate Study

For undergraduate curriculum in veterinary medicine leading to the degree Doctor of Veterinary Medicine, see *Veterinary Medicine, Curriculum*

A thorough study of basic physiology is necessary to understand the mechanisms and the treatment of animals diseases. The study of comparative mammalian physiology gives students a background in the functional activities of cells, tissues, organs, and systems with special consideration for the basic physiology of importance to veterinary medicine

An understanding of drug action is essential for rational drug therapy. The general pharmacology courses provide students with a background in basic pharmacology to include pharmacodynamics, toxicology, and the clinical application of drugs Special emphasis is placed on chemical agents and therapeutic practices specific to veterinary medicine

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with majors in physiology or in physiology with pharmacology as a specialization, and minor work for students majoring in other departments

Cooperative programs between Veterinary Physiology and Pharmacology and the Biomedical Engineering Program are provided jointly under sponsorship by the colleges of Engineering and Veterinary Medicine See *Biomedical Engineering*. The department also participates in the interdepartmental program in Molecular, Cellular and Developmental Biology

Fundamental knowledge of anatomy, biochemistry, chemistry, mathematics, physiology, and zoology is considered prerequisite for major study in the department

Foreign language requirements may be established by the student's graduate advisory committee

Open to graduate students for minor credit only 360

Courses Primarily for Undergraduate Students

229 Physiology of Domestic Animals. (3-0) Cr 3 F S *Prereq Biol 101* Fundamentals of physiology and their applications to domestic animals.

350. Comparative Veterinary Physiology. (3-0) Cr 3 F *Prereq First year classification in veterinary medicine* Membrane, neural, muscular and cardiovascular physiology

351 Comparative Veterinary Physiology. (5-0) Cr 5 S Renal, respiratory, fluid and acid-base balance, endocrine, reproductive and alimentary physiology

360. General Pharmacology. (4-0) Cr 4 F *Prereq 351 or 552* General principles, drug disposition, drugs acting on the nervous, cardiovascular, renal, gastrointestinal, and endocrine systems, antimicrobials and antineoplastics.

361 Pharmacology and Therapeutics. (2-0) Cr 1 S 8 weeks *Prereq 360* Pharmacology and therapeutic uses of fluids, antiparasitic drugs, and selected drugs in veterinary practice; adverse drug reactions.

365. Physiological Sciences Laboratory. (0-4) Cr. 2. S *Prereq 360* Laboratories designed to illustrate basic principles of the physiology of domestic animals and the pharmacology of selected drugs.

366. Physiological Sciences Laboratory. (0-4) Cr 2 F *Prereq 365* Laboratories designed to illustrate basic principles of the physiology of domestic animals and the pharmacology of selected drugs.

490. Independent Study. Cr 1-5 each time taken *Prereq Permission of Instructor.*
H Honors.

501, 502. Selected Research Methods in Pharmacology. (0-8) Cr 3 each. 501:F , 502:S. *Prereq Graduate classification, permission of pharmacology staff* Experience in pharmacologic techniques in selected pharmacology laboratories: cytochemical methods, extracellular and intracellular unit recording, microiontophoresis, spectrophoto-fluorometric analysis of biogenic amines, atomic absorption spectrometry, radioimmunoassay, gas chromatography, enzyme analysis, use of isotopes in drug studies, intestinal perfusion techniques, renal clearance methods, and isolated tissue bioassay

531. Physiology and Pharmacology of Synaptic Transmission. (2-0) Cr 2 Alt S , offered 1982 *Prereq 551, permission of instructor* Randic and VanMeter Anatomical distribution, actions, biochemical aspects of synthesis and degradation, release of possible transmitter substances in mammalian central nervous system Several amino acids, acetylcholine, catecholamines, 5-hydroxytryptamine, and some peptides of interest in neurobiology Various drugs will be introduced where their action is related to the subject under discussion

533. Physiology and Endocrinology of Animal Reproduction. (An S 533) (3-0) Cr 3 S *Prereq General physiology course* Development of structure and function of the reproductive system Physiologic and endocrine aspects include puberty, gametogenesis, estrous cycle, pregnancy, parturition, and the interaction of environment, thyroid and adrenal function, and nutrition with these processes

551, 552. Advanced Vetebrate Physiology. (B M E 551, 552) (Zool 551, 552) (4-3) Cr 5 each 551 F , 552 S *Prereq B M E 509 or Zool 320 and Zool 455, 455L, credit or classification in B B 404 or 420* Primarily mammalian physiology 551 Neurophysiology, neuroendocrine, endocrine, muscle, temperature regulation 552 Body fluids, respiratory, renal, cardiovascular, digestion, metabolism

560 (360 DL) General Pharmacology. (4-3) Cr 5 F *Prereq V P P 551 and 552, BB 404, 405* Graduate study in conjunction with V P P 360 General principles, drug disposition, drugs acting on the nervous, cardiovascular, renal, gastrointestinal, and endocrine systems, antimicrobials and antineoplastics

565. Physiology and Pharmacology of the Autonomic Nervous System. (2-0) Cr 2 Alt S , offered 1983 *Prereq 551, 552* Dyer Storage, release, and receptors mediating the effects of autonomic transmitter substances, control and regulation of internal functions and visceral organs

590. Special Topics. Cr 1 to 7 *Prereq Permission of instructor*
A. Physiology
B Pharmacology

Courses for Graduate Students, major or minor

630. Alimentary Physiology (3-0) Cr 3 Alt S , offered 1982 *Prereq 552* Crump, staff A comparative study of ruminants and non-ruminants with emphasis on motility, secretion, digestion, and absorption

631. Experimental Techniques in Physiology (2-6) Cr 4. Alt S , offered 1983 *Prereq 552* Hembrough, staff Possession of surgical skills recommended Basic physiology in animals utilizing various techniques such as fistulas, bypasses, blood flow determinations, and others

652. Respiratory Physiology. (2-1) Cr 3 Alt F , offered 1982 *Prereq 552* Engen Review of current research literature on hemodynamics of respiratory system, lung mechanics, gas diffusion, surfactant, and related topics

667. Qualitative Pharmacology: Isolated Tissues. (0-8) Cr 4 S *Prereq 360 or 560, permission of instructor* VanMeter Laboratory experiments using a variety of isolated smooth muscle, cardiac, and nerve-muscle preparations to study qualitative drug responses Emphasis on technique and reporting of laboratory data

668. Quantitative Pharmacology: Bioassy. (0-8) Cr 4 S *Prereq 667* VanMeter Pharmacological experiments designed to assay agonists and antagonists using principles and techniques of biological standardization and biostatistics

690. Advanced Topics. Cr 1 to 5 *Prereq. Permission of instructor*
A. Physiology
B Pharmacology

698. Seminar. Cr 1 F S SS Staff

699. Research
A Physiology
B Pharmacology

Water Resources

(Interdepartmental Major)

Merwin D Dougal, Chair, Supervisory Committee

Supervisory Committee: R W Bachmann, E R Baumann, G E Bivens, T J Bom, G L Bultena, E L Denisen, J D Dodd, J N Hathcock, H P Johnson, D Kirkham, H D Meeks, B E Nordlie, P J Reilly, D M Roberts, R B Talbot, J F Timmons, H W Walker

Work is offered for the degrees Master of Science (thesis and nonthesis options) and Doctor of Phylosophy with major in water resources under a cooperative arrangement with various departments including Agricultural Engineering, Agronomy, Animal Ecology, Bacteriology, Botany, Chemical Engineering, Civil Engineering, Earth Sciences, Economics, Family Environment, Food and Nutrition, Food Technology, Forestry, Horticulture, Industrial Engineering, Nuclear Engineering, Political Science, and Sociology Minor work is offered to students taking major work in other areas Facilities exist in several departments for fundamental research in such areas as source, distribution, and movement of water or hydrology, and hydraulics of water control facilities (water quanitity), physical, biological, and chemical properties of water (water quality), and social, legal, and economic aspects of water resource development (water resources economics and institutions)

Students majoring in water resources will choose a major professor from the graduate faculty membership of the cooperating departments and will develop the program of study under the guidance of a committee nominated by the administrative department head, approved by the departmental water resources supervisory committee representative, and appointed by the dean of the Graduate College For administrative purposes, students will be in the department of their major professor

For the degrees Master of Science and Doctor of Philosophy, the foreign language reuqirement, if any, is established on an individual basis by the student's program of study committee For the nonthesis Master of Science degree, the student must complete at least 50 credit hours of acceptable work, including a WR 590 creative component acceptable to the student's program of study committee

Water Resources Interdisciplinary Courses

The interdisciplinary, interdepartmental water resources educational program consists of the three-semester sequence in water resources relating to (1) water quantity, (2) water quality, and (3) water resources economics and institutions In addition, a special topics category and a water resources seminar category are offered. The Water Resources Interdepartmental Supervisory Committee encourages appropriate use of the water resources seminar, and will make it available insofar as possible both spring and fall semester. Appropriate interdisciplinary field trips to resource locations in Iowa and the Midwest are encouraged, particularly during the summer sessions

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

577. Water Resources I (C E 577) (3-0) Cr 3 F *Prereq Permission of Water Resources Supervisory Committee* Introduction to water resources planning Hydrology, including source, distribution and measurement of water, water management categories and beneficial use groups, demand for water, hydraulics and water control facilities Administered by Civil Engineering Cooperative with Agriculture Engineering, Agronomy, and Earth Sciences

578. Water Resources II. (C E 578) (3-0) Cr 3 S *Prereq Permission of Water Resources Supervisory Committee* Water resources planning The role of quality in water resources physical, chemical, and biological aspects of water and waste water Administered by Civil Engineering Cooperative with Animal Ecology, Botany, and Food Technology

579. Water Resources III. (Econ 579) (3-0) Cr 3 S *Prereq Permission of Water Resources Supervisory Committee.* Water resources planning Water management categories and beneficial use groups, water demands for various uses Legal, economic, sociological, governmental and technical aspects of water resources planning and management Emphasis on systems of rational allocation among competing demands for water Administered by Economics, cooperative with Sociology, Political Science, and other cooperating departments

590 Special Topics. Cr Var *Prereq Permission of major professor in cooperating department* Literature reviews and conference in accordance with needs and interest of the student Creative component for nonthesis master of science degree

690 Seminar in Water Resources Management. (1-0) Cr 1 F S *Prereq Permission of Water Resources Supervisory Committee and major professor*

Women's Studies

Program Committee: Linda R Galyon, Chair, R W Bernard, G M Ebert, B A Glatz, K K Hickok, M Y Lee, J S Rasmussen, two student members

Women's Studies is a cross-disciplinary program in the College of Sciences and Humanities in which students may elect a minor area of study or a concentrated area of study under distributed studies The program consists of core courses from the disciplines of economics, English, history, physical education, political science, psychology, sociology, and women's studies

Women's studies provides an opportunity for students to investigate women's roles, contributions, and status in a social and cultural context that embraces a variety of disciplines.

Core courses in women's studies are listed below For information on supporting courses, contact the chairperson of the program committee or the cross-disciplinary office Any student interested in a minor in women's studies should contact the chairperson of the program committee for advising

201. Introduction to Women's Studies. (3-0) Cr 3 F The status of women today from a social, economic, historical, political, philosophical and literary perspective Background for the other core courses in the program

327. Sex Roles in Modern Society (Soc 327) See *Sociology*

345. Literature by or About Women. (Engl 345) See *English.*

346. Psychology of Women. (Psych 346) See *Psychology*

385. Women in Politics. (Pol S 385) See *Political Science*

386. History of Women in America. (Hist 386) See *History*

446. Economics of Discrimination. (Econ 446) See *Economics*

490. Independent Study. *Prereq Any two core courses in Women's Studies, permission of instructor with whom student proposes to work* A study proposal must be submitted to the program committee in advance See Index, *Cross-Disciplinary Programs.*

523. Sex Roles and Sport. (P E 523) See *Physical Education*

Zoology

John B Balinsky, Chair of Department

Professors: Balinsky, Bishop, Brown, Buttrey, Dolphin, Dunham, Jeska, Mutchmor, Redmond, Ulmer

Emeritus Professors: Harding, Haupt, Hicks, Tauber

Associate Professors: Baker, Drewes, Ellis, Emery, Hoffman, Mayfield, Mitchell, Powell, Shaw, Viles

Assistant Professors: Blaustein, Carlson, Farrar, Fassel, Hallberg, Shen

Undergraduate Study

For undergraduate curriculum in sciences and humanities, with major in zoology, see *Sciences and Humanities, Curriculum*

In addition to basic degree requirements listed in the *Sciences and Humanities Curriculum,* zoology majors (including those preparing for professional programs in medical and other health-related areas) must complete satisfactorily the following requirements

1 Biol 110
2 Zool 206, 206L, 325 and 355
3 18 zoology credits at the 300 level or above which must include at least 7 credits at the 400 level or above, and three zoology courses with laboratories in addition to Biol 110L, Zool 206L, and Zool 355
4 1 year of introductory chemistry and 1 semester of organic chemistry
5 1 semester of biochemistry
6 6 credits of mathematics chosen from the following areas calculus, statistics or computer science
7 1 year of general college physics
8 1 year of one foreign language in college or 2 years of one foreign language in high school
9 English proficiency represented by a grade of C or better in elementary English composition

One or more courses in botany, or microbiology, or both, are highly recommended

The flexibility of the requirements for the B S in zoology allows and encourages students interested in graduate work to specialize in one of several areas of zoology

Specific entrance requirements for medical and health-related professions are established by the professional schools Students interested in fulfilling preprofessional requirements for such professions as cytotechnology, dental hygiene, dentistry, human medicine, medical technology, nursing, optometry, pharmacy, physical therapy, physican's assistant, and veterinary medicine can major in zoology while fulfilling the preprofessional requirements (See *Preprofessional Study)*

Training in zoology may lead to employment in teaching, research, conservation, extension service, industrial and hospital laboratory work, technical writing or illustration, and as practitioners in medicine and other health related professions Zoology majors interested in research or college level teaching must plan on continuing their education in graduate school

Majors are encouraged to take advantage of the special opportunities available in summer courses at the Iowa Lakeside Laboratory at Lake Okoboji and at the Gulf Coast Research Laboratory, Ocean Springs, Mississippi (See Index) Interested students should consult their advisers

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with majors in zoology, or molecular, cellular, and developmental biology Both degrees require the completion of original research and written thesis or dissertation A student majoring in zoology may specialize in animal behavior, cell biology, molecular biology, developmental biology, comparative physiology, ecology, endocrinology, immunobiology, neurobiology, parasitology, physiology In addition to the program in Molecular, Cellular and Developmental Biology, the department also participates in the interdepartmental program in Immunobiology (See Index)

Students entering the graduate program in the department must be committed to research and need a sound background in the biological, physical, and mathematical sciences Applicants are required to submit Graduate Record Examination (GRE) scores for both the aptitude and the biology advanced area tests

Specific course requirements for advanced degrees depend largely upon previous training and experience in the major area of specialization There is no foreign language requirement for the M S degree Proficiency in one foreign language is required for the Ph D degree The student's committee may require additional language competence Certification in the use of written English is also required. All graduate students must acquire teaching experience in laboratory courses as part of their graduate program

During the summer certain graduate courses in zoology are taught, and special research projects are supervised, at the Iowa Lakeside Laboratory, Lake Okoboji

Open to graduate students for minor credit only 428, 434, 434L

Courses Primarily for Undergraduate Students

100 Opportunities in Zoology. (1-0) Cr 1 F Orientation to the area of zoology Specializations and career opportunities in the zoological sciences, including medically related professions Offered on a satisfactory-fail basis only

155. Basic Human Physiology and Anatomy. (3-0) Cr 3 F S SS *Prereq H S biology and chemistry or Biol 109 or Biol 110, Biol 109 or 110 recommended* The structure and functions of human organ systems.

156. Laboratory in Human Physiology and Anatomy. (0-4) Cr 2 F S SS *Prereq. Credit or classification in 155* Introduction to selected aspects of human anatomy and physiology through the use of models, specimens, and student conducted experiments

206. General Zoology. (3-0) Cr 3. F S.SS *Prereq Biol 110* Phylogeny, anatomy, physiology, and early development of animals

206L. General Zoology Laboratory. (0-6) Cr 2 F S.SS *Prereq: Credit or classification in 206.* Detailed anatomical study of selected vertebrates and invertebrates, introductory classification, and life histories.

258. Human Reproduction. (3-0) Cr 3 F *Prereq 155 or Biol 109 or Biol 110* Anatomy and physiology of human

reproductive systems, including fertility, pregnancy, and delivery

303. **Biological Evolution.** (Biol 303) Cr 3 See *Biology*.

304. **Animal Behavior.** (3-0) Cr 3. (3-3) Cr 4 F *Prereq 206* Orientative, communicative, social, genetic, developmental, ecologic, and evolutionary aspects of behavior Laboratory techniques for observation, description and analysis of animal activities; independent projects.

311 **Introduction to Parasitology.** (Micro 311) (3-3) Cr 4 F *Prereq 206L.* Biology and host-parasite relationships of major groups of animal parasites, and techniques of diagnosing and studying parasites.

320 **Comparative Chordate Anatomy.** (2-4) Cr 4 F *Prereq 206L.* Selected chordates with emphasis on adaptation and evolution

322. **Vertebrate Histology.** (2-4) Cr. 4 S *Prereq 206L, 320 recommended.* Selected vertebrate tissues studied microscopically

325 **Cellular Physiology.** (3-0) Cr 3 F *Prereq. 206 or Biol 110* Principles of cell structure and function

355. **Principles of Physiology.** (3-3) Cr. 4 F.S.SS. *Prereq 206, 206L, and either 325 or organic chemistry* Introduction to systemic functions with emphasis on vertebrates

357 **Physiology of Human Reproduction.** (2-0) Cr 2 S. *Prereq 258, permission of instructor.* Study and discussion of current research in human reproductive physiology

405. **Advanced Invertebrate Zoology.** (3-0) Cr 3 or (3-6) Cr 5 Alt F, offered 1982. *Prereq: 325 or 355; permission of instructor to enroll in lab* In-depth study of selected invertebrate groups, analysis of current research topics

428. **Cell Biology.** (3-0) Cr 3. Alt S, offered 1982 *Prereq 325.* Biological organization and function at the cellular level Emphasis on biomembranes.

434. **Developmental Biology.** (3-0) Cr 3. F *Prereq 206L, 325* Key concepts, experiments, and observations of developmental biology

434L. **Developmental Biology Laboratory.** (0-6) Cr 2 F *Prereq Credit or classification in 434* Observations and experiments on developmental aspects of selected organisms

450L. **Cellular Physiology Laboratory.** (1-6) Cr 3 Alt. S, offered 1982 *Prereq 325 and a course in biochemistry* Modern experimental techniques in cellular and molecular physiology Laboratory projects Emphasis on fractionation, membrane and organelle function, transport, and regulation

454. **General and Comparative Endocrinology.** (3-0) Cr 3 or (3-3) Cr 4 Alt S, offered 1983 *Prereq: 355, a course in biochemistry.* Chemical integration of vertebrate organisms The structure, development, and evolution of the endocrine glands and the function and structure of their hormones Laboratory techniques for studying hormonal phenomena.

456. **Introduction to Neurobiology.** (3-0) Cr 3 or (3-3) Cr 4 S *Prereq 355 or Psych 311, physics recommended, permission of instructor to enroll in lab* Integration, coding, plasticity, and development in nervous systems.

459. **Environmental Physiology.** (3-0) Cr 3 or (3-3) Cr 4 Alt F, offered 1981 *Prereq: 355, physics recommended* Physiological adaptations to the environment with an emphasis on vertebrates

490 **Independent Study.** Cr 1 to 5 each time taken. *Prereq 15 credits in zoological sciences, permission of instructor*

S Cr 1 Attendance and critique of zoology seminars
U Laboratory teaching experience, maximum of 2 credits. For students registering to be undergraduate laboratory assistants.
Z Zoology

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

505. (405 DL) **Advanced Invertebrate Zoology.** (3-0) Cr 3 or (3-6) Cr 5. Alt. F., offered 1982. *Prereq: 325 or 355, permission of instructor to enroll in lab.* Graduate study in conjunction with 405. In-depth study of selected invertebrate groups; analysis of research topics. Not open to students who have credit in 405.

506. **Host-Parasite Systems.** (Micro 506) (2-0) Cr 2 F *Prereq A course in parasitology.* Detailed examination of host-parasite relationships involving parasitic helminths, protozoa and arthropods

507. **Advanced Animal Behavior.** (2-0) Cr 2 Alt S, offered 1983 *Prereq 304* Analysis of current research in animal behavior

512. **Vertebrate Behavioral Ecology.** (A Ecl 512) See *Animal Ecology*

528. **Cellular Growth and Regulation.** (3-0) Cr 3 F *Prereq Courses in cell biology and biochemistry* Cell cycle, regulation of cell growth, cell division, membranes, transport processes, and regulation of cellular activities

534. **Molecular Development and Differentiation.** (3-0) Cr 3. S *Prereq Courses in developmental and cell biology.* Molecular biology of eucaryotic cells emphasizing developmental events.

550. **Comparative Physiology of Respiration and Circulation.** (2-0) Cr 2 Alt S, offered 1983 *Prereq 355* Respiratory gas exchange by aquatic and aerial invertebrates and vertebrates Functions of circulatory systems in gas exchanges Emphasis on basic aspects of aquatic and aerial respiration, and adaptations to environments posing special respiratory problems

551. **Advanced Vertebrate Physiology I.** (4-3) Cr 5 F *Prereq 355, 320 or B M E 525, credit or classification in B B 420 or 404* Neurophysiology, sensory systems, muscle, neuroendocrinology, endocrinology

552. **Advanced Vertebrate Physiology II.** (4-3) Cr 5 S *Prereq 355, 320 or B M E 525, credit or classification in B B 420 or 404* Cardiovascular, renal, respiratory physiology, and digestion

554. (454 DL) **General and Comparative Endocrinology.** (3-0) Cr 3 or (3-3) Cr 4. Alt S, offered 1983 *Prereq 355, a course in biochemistry* Graduate study in conjunction with 454 Chemical integration of vertebrate organisms The structure, development, and evolution of the endocrine glands and the function and structure of their hormones Laboratory techniques for studying hormonal phenomena.

556. (456 DL) **Introduction to Neurobiology.** (3-0) Cr. 3 or (3-3) Cr 4 S *Prereq: 355 or Psych 311, physics recommended; permission of instructor to enroll in lab* Graduate study in conjunction with 456 Integration, coding, plasticity, and development in nervous systems

559. (459 DL) **Environmental Physiology.** (3-0) Cr 3 or (3-3) Cr 4 Alt F, offered 1981. *Prereq. 355, physics recommended* Graduate study in conjunction with 459 Physiological adaptations to the environment with emphasis on vertebrates

560. **Immunoparasitology.** (V Pth 560) See *Veterinary Pathology*

590. **Special Topics.** Cr 1 to 5 each time taken *Prereq Permission of instructor*

Courses for Graduate Students, major or minor

610 **Current Topics in Parasite Ultrastructure and Physiology.** Cr 2-3 each time taken *Prereq 506, permission of instructor* Critical analysis of current literature in fine structure and physiology of parasites

612. **Current Topics in Parasite Ecology, Evolution and Systematics.** (Micro 612) Cr 2-3 each time taken *Prereq: 506, permission of instructor.* Critical study of current literature concerning special adaptations of parasites in relation to specific microenvironments, parasite population biology and behavior, modern approaches to systematics

630 **Current Topics in the Cellular and Molecular Biology of Animal Systems.** Cr 2-3 each time taken *Prereq 528* Topics from cell organel function, cellular interactions, and eucaryotic molecular biology

631. **Advanced Developmental Biology.** Cr 2-3 each time taken *Prereq 434* Presentations and discussion of selected research topics in developmental biology

632. **Cellular Regulation.** Cr 2-3 each time taken *Prereq 528 or B B 526* In-depth analysis of selected cellular control mechanisms Emphasis on the regulation of protein levels and the action of selected hormones on cell function

633. **Comparative Molecular Physiology.** Cr 2-3 each time taken *Prereq. 355 and 1 year of biochemistry* Selected topics on comparative aspects of energetics, anaerobiosis, anhydrobiosis, nitrogen metabolism, ionic and osmotic regularion Emphasis on lower vertebrates and invertebrate animals

650. **Current Topics in Physiology.** Cr 2-3 each time taken *Prereq: 355, permission of instructor* Topics from comparative physiology, environmental physiology, mammalian physiology, selected physiological techniques

654. **Advanced Endocrinology.** (2-0) Cr. 2 each time taken Alt S, offered 1982 *Prereq 454 or 551, 552* Selected aspects of endocrine function in vertebrates

655. **Insect Physiology.** (Ent 655) See *Entomology*

660. **Current Topics in Neurobiology and Behavior.** Cr 2-3 each time taken *Prereq. Permission of instructor.* Topics may include communication, hormones and behavior, neural integration, neuroanatomy and ultrastructure, sensory biology, social behavior, techniques in neurobiology and behavior

690. **Seminar in Zoology.** Cr 1 each time taken Offered on a satisfactory-fail basis only
A Cellular, Molecular, and Developmental Biology
B Invertebrate Zoology and Parasitology
C Neurobiology and Behavior
D Physiology

698 **Seminar in Molecular, Cellular, and Developmental Biology.** (MCDB 698) See *Molecular, Cellular, and Developmental Biology*

699. **Research**

*Courses Offered at the Iowa Lakeside Laboratory

302L. (L:101) **Field Biology.** (4-12) Cr 2.5 SS Animals in the field, with particular emphasis on their recognition and on collecting, preserving, and laboratory culture methods Field trips. Must be taken concurrently with Bot 301L.

371L. (L:118) **Field Entomology.** (8-24) Cr 5 SS Survey of insect world including classification, life history, literature, and ecology Emphasis on field observations, making and naming personal collection of insects Field trips

490Z. **Independent Study.** (See preceding section)

508L, 509L. (L:103, L:104) **Aquatic Ecology.** (8-24) Cr 5 each SS Survey of local aquatic organisms and aquatic habitats, analysis of physiolographic, physical, and chemical factors Emphasis on field work, methodology, and basic ecological principles Field Trips

512L. (L:107) **Helminthology.** (8-24) Cr 5 SS *Prereq 206L, 15 credits in zoology* Survey of cestodes, trematodes, and nematodes parasitic in wildlife, laboratory animals, and man, study of selected vectors, identification, life histories, and host-parasite relationships emphasized

516L. (L.110) **Symbiotic Relationships.** Cr 5 SS *Prereq 15 credits in zoology* Field and laboratory studies of the major types of symbioses, including commensalism, parasitism, and mutualism Emphasis on field studies of relationships involving aquatic animals of the Okoboji region. For advanced undergraduates and graduate students

590. **Special Topics.** (See preceding section.)

699. **Research.** (See preceding sections.)

**Courses Offered at the Gulf Coast Research Laboratory, Ocean Springs, Mississippi

207G. **Introduction to Marine Zoology.** Cr 4 SS Prereq. 12 credits in biological sciences. General introduction to the marine environment; emphasis on local fauna. Field trips

307G. **Marine Invertebrate Zoology.** Cr 8 SS *Prereq 24 credits in zoology, including an introductory course in invertebrate zoology* Concentrated study of free-living, marine invertebrates of the Mississippi Sound and adjacent continental shelf of the northeastern Gulf of Mexico Emphasis on structure, classification, phylogeny, larval development, and functional processes.

320G. **Marine Vertebrate Zoology and Ichthyology.** Cr 6 SS *Prereq 24 credits in zoology, including comparative anatomy* General study of marine chordates, including fishes, amphibians, reptiles, birds and mammals Emphasis on fishes.

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*Written permission of the instructor is prerequisite to all courses offered at the Iowa Lakeside Laboratory. For current information concerning courses, registrations, and housing, see the annual Iowa Lakeside Laboratory Bulletin. This bulletin is usually available from participating departments after February 15. Numbers beginning with L indicate numbers used by the University of Iowa.

**Written permission of the coordinator of the Gulf Coast Research Laboratory, 201 Bessey Hall, Iowa State University, Ames, Iowa, 50011, is prerequisite to all courses offered at the Laboratory.

The Faculty

The General Faculty consists of the President, Vice Presidents, Deans, all persons with regular or adjunct academic rank, and such other members of the University staff as the President may designate. The Dean of Admissions and Records serves as secretary

PARKS, W. ROBERT, President; Professor of Political Science. B.A., 1937, Berea; M.A., 1938, Kentucky; Ph.D., 1948, Wisconsin; LL.D., 1966, Berea; L.H.D., 1968, Westmar; LL.D., 1968, Drake; D.Sc., 1973, Kentucky. 1958.

HILTON, JAMES H., Emeritus President, B.S., 1923, Iowa State; M.S., 1937, Wisconsin; D.Sc., 1945, Purdue; D.Sc., 1953, Cornell; D.Sc., 1955, North Carolina State; D.Sc., 1965, Iowa State; LL.D., 1965, Lenoir Rhyne. 1953.

ABATZOGLOU, THEAGENIS J., Assistant Professor of Mathematics. B.S., 1971, California Institute of Technology; Ph.D., 1976, California (Irvine). 1976, 1978.*

ABBOTT, ERIC A., Associate Professor of Journalism and Mass Communication. B.S., 1967, Iowa State; M.S., 1970, Ph.D., 1974, Wisconsin. 1974, 1977.

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ABIAN, ALEXANDER, Professor of Mathematics. M.S., 1954, Chicago; Ph.D., 1956, Cincinnati. 1967

ABOU-GABAL, MOUSTAFA, Associate Professor of Veterinary Microbiology and Preventive Medicine. B.V.Sc., 1962, Cairo (Eygpt); M.D Vet., 1970, Hannover (West Germany). 1974, 1978.

ABRAHAM, WILLIAM H., Professor of Chemical Engineering. B.Ch.E., 1952, Cornell; Ph.D., 1957, Purdue. 1962, 1967.

ABRAHAMS, MICHAEL, Assistant Professor of Economics. B.A., 1973, California (Santa Barbara); M.A., 1977, Ph.D., 1980, California (Berkeley). 1980

ADAMS, DONALD R., Associate Professor of Veterinary Anatomy. M.A., 1967, California State (Chico); Ph.D., 1970, California (Davis). 1974, 1976.

ADAMS, HARRIET, Emeritus Professor of Art and Design; Emeritus Professor of Home Economics Studies. B.Des., 1930, Kansas; M.A., 1934, Case Western Reserve. 1944, 1957

ADAMS, JEAN W., Associate Professor of Economics B.A., 1969, M.A., 1971, Ph.D., 1973, Illinois. 1972, 1979.

ADAMS, ROY D., Associate Professor of Economics B.A., 1968, M.A., 1971, Ph.D., 1972, Illinois 1972, 1978.

ADAMS, SAMUEL K., Associate Professor of Industrial Engineering. B.Mgt.E., 1960, Rensselaer; M.S.E., 1962, Ph.D., 1966, Arizona State. 1974.

AHMANN, J. STANLEY, Professor of Professional Studies in Education and Chair of the Department; Professor of Psychology. B.A., 1943, Trinity; B.S., 1947, M.S., 1949, Ph.D., 1951, Iowa State. 1975

AHRENS, FRANKLIN A., Professor of Veterinary Physiology and Pharmacology. B.S., D.V.M., 1959, Kansas State; M.S., 1965, Ph.D., 1968, Cornell. 1968, 1975.

AIGNER, STEPHEN M., Assistant Professor of Sociology. B.A., 1967, Knox; M.S.W., 1969, M.A., 1972, Ph.D., 1976, Michigan. 1973, 1977.

AITCHISON, GARY L., Associate Professor of Business Administration. B.A., 1956, Northern Iowa, M.A., 1961, Northern Colorado; Ph.D., 1972, Iowa State. 1965, 1975.

AKERS, ARTHUR, Associate Professor of Engineering Science and Mechanics. B.Sc., 1953, London (England); M.Sc., 1955, Cranfield (England); Ph.D., 1969, London (England). 1975, 1980.

ALLEN, BENJAMIN J., Associate Professor of Business Administration. B.S., 1969, Indiana; M.A., 1973, Ph.D., 1974, Illinois. 1979.

ALLEN, CRAIG M., Assistant Professor of Family Environment. B.S., 1972, M.S., 1975, Brigham Young; Ph.D., 1980, New Hampshire. 1980.

ALLEN, EDWARD S., Professor of Mathematics. A.B., 1909, A.M., 1910, Ph.D., 1914, Harvard. 1921, 1943.

ALLEN, PHILIP M., Professor of Art and Design. B.F.A., 1960, M.F.A., 1961, Drake. 1967, 1979.

*The first date indicates the date of appointment to the Faculty; the second date, when the first falls to do so, indicates the date of appointment to present rank.

ALLISON, MILTON J., Professor of Veterinary Physiology and Pharmacology (Collaborator). B.S., 1953, M.S., 1954, South Dakota State; Ph.D., 1961, Maryland. 1977.

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ALMQUIST, JAMES C., Associate Professor of Agricultural Studies. B.S., 1954, M.S., 1962, Iowa State. 1967, 1974.

ALT, KLAUS F., Assistant Professor of Economics (Collaborator). B.S., 1968, Oregon State; M.S., 1970, Illinois; Ph.D., 1976, Iowa State. 1969, 1980.

AMEMIYA, MINORU, Professor of Agronomy. B.S., 1942, California (Berkeley); M.S., 1948, Ph.D., 1950, Ohio State. 1968, 1971.

AMOS, ROSALIE J., Assistant Professor of Home Economics Education; Assistant Professor of Secondary Education. B.S., 1953, Iowa State; M.S., 1960, Ph.D., 1976, Cornell. 1978.

AMUNDSON, CURTIS M., Adjunct Instructor in Animal Science. B.S., 1977, Iowa State; M.S., 1979, Oklahoma State. 1980.

ANDERSON, CARL E., Associate Professor of Agricultural Engineering. B.S.A.E., 1962, Pennsylvania State; M.S.A.E., 1965, Arizona; Ph.D., 1975, Kansas State. 1973, 1979.

ANDERSON, DALE A., Professor of Aerospace Engineering. B.S., 1957, St. Louis; M.S., 1959, Ph.D., 1964, Iowa State. 1965, 1975.

ANDERSON, DALE L., Instructor in Physical Education; Head Men's Golf Coach. B.A., 1958, Luther; M.A., 1970, Iowa. 1967.

ANDERSON, DEAN F., Assistant Professor of Physical Education. B.S., 1968, M.A., 1972, Ph.D., 1978, Minnesota. 1976, 1978.

ANDERSON, E. WALTER, Associate Professor of Physics. M.A., 1961, Ph.D., 1965, Columbia. 1972, 1976.

ANDERSON, IRVIN C., Professor of Agronomy; Professor of Botany. B.S., 1951, Iowa State; M.S., 1954, Ph.D., 1957, North Carolina State. 1958, 1967.

ANDERSON, JANET I., Assistant Professor of English. Ph.B., 1967, Northwestern; M.A., 1972, Ph.D., 1976, Illinois. 1978, 1979.

ANDERSON, JULIA F., Professor of Home Economics Studies; Associate Dean of the College of Home Economics B.S., 1941, Iowa State; M.S., 1947, Washington. 1947, 1962.

ANDERSON, LESLIE A., Adjunct Instructor in Physical Education. B.S., 1960, M.S., 1969, Iowa State 1978

ANDERSON, LLOYD L., Professor of Animal Science B.S., 1957, Ph.D., 1961, Iowa State. 1958, 1971

ANDERSON, MARVIN A., Emeritus Dean of University Extension. B.S., 1939, M.S., 1949, Ph.D., 1955, Iowa State. 1939, 1957.

ANDERSON, PAUL F., Assistant Professor of Landscape Architecture, Assistant Professor of Agronomy. B.S., 1972, M.L.A., 1974, Iowa State 1977, 1979

ANDERSON, RUSSELL D., Assistant Professor of Electrical Engineering. B.S., 1960, B.S., 1961, M.S., 1964, Ph.D., 1979, Iowa State 1961, 1976.

ANDERSON, WILLARD R., Assistant Professor of Agricultural Engineering. B.S., 1950, M.S., 1952, Iowa State. 1950, 1956.

ANDRE, THOMAS, Associate Professor of Psychology; Associate Professor of Secondary Education. B.S., 1967, Massachusetts; M.A., 1970, Ph.D., 1971, Illinois. 1974, 1977.

ANDREWS, JOHN J., Professor of Veterinary Pathology, Veterinary Medical Diagnostic Laboratory D.V.M., 1968, Iowa State; M.S., 1973, Michigan State 1978, 1979.

ANGELICI, ROBERT J., Professor of Chemistry and Chair of the Department. B.S., 1959, St. Olaf; Ph.D., 1962, Northwestern. 1963, 1971.

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APT, LEON J., Professor of History B.A., 1956, M.A., 1957, Arkansas; Ph.D., 1965, Chicago. 1969, 1974.

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ARGENZIO, ROBERT A., Associate Professor of Veterinary Physiology and Pharmacology (Collaborator). B.S., 1966, M.S., 1968, Colorado State; Ph.D., 1971, Cornell. 1978.

ARNBAL, CARL A., Associate Professor of Freshman Engineering. B.M.E., 1946, Minnesota; M.S., 1955, Kansas State; M.S., 1965, Iowa State. 1952, 1965.

ARNOLD, FLOYD J., Professor Emeritus of Animal Science. B.S., 1926, M.S., 1940, Iowa State. 1927, 1960.

ARNOLD, LIONEL K., Professor of Chemical Engineering. B.S., 1921, M.S., 1930, Ph.D., 1930, Iowa State. 1931, 1948.

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ATHERLY, ALAN G., Professor of Genetics and Chair of the Department; Professor of Microbiology; Professor of Biochemistry B.S., 1959, Western Michigan; Ph.D., 1964, North Carolina. 1968, 1976.

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AUSTIN, T. AL, Professor of Civil Engineering B.S.C.E., 1967, Texas Tech; M.S., 1970, Utah State, Ph.D., 1971, Texas Tech. 1972, 1979.

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BARNUM, MARION P., Associate Professor of Music. Dipl , 1951, Julliard; M.F.A., 1966, D.M.A., 1971, Iowa. 1971, 1972

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BARTON, THOMAS A., Professor Emeritus of Landscape Architecture. B.S., 1941, M.L.A., 1960, Iowa State 1955, 1962.

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BAUM, DALE D., Associate Professor of Elementary Education. B.S., 1954, Ohio State; M.Ed., 1967, Missouri; Ed.D., 1970, Kansas. 1977.

BAUMANN, E. ROBERT, Professor of Civil Engineering; Anson Marston Distinguished Professor in Engineering. B.S.E., 1944, Michigan; B.S., 1945, M.S., 1947, Ph.D , 1954, Illinois. 1953, 1957.

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BAUMGARTEN, JOSEPH R., Professor of Mechanical Engineering. B.S.M.E., 1950, Dayton; M.S.M.E., 1955, Ph D , 1958, Purdue. 1978.

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BEAL, GEORGE M., Emeritus Professor of Sociology; Charles F Curtiss Distinguished Professor in Agriculture (Emeritus). B.S., 1943, M.S., 1947, Ph.D., 1953, Iowa State. 1948, 1957.

BEARD, JESS R., Professor of Elementary Education and Head of the Department. B.S., 1947, M.S., 1947, Illinois; Ed.D., 1958, George Peabody. 1967, 1970.

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BEAVERS, WILLET L, Associate Professor of Physics. B.S., 1955, M.S., 1959, Missouri; Ph.D., 1965, Indiana. 1965, 1969.

BEELL, THOMAS L., Assistant Professor of Journalism and Mass Communication. B.A., 1965, Washington; M.A., 1972, Wisconsin. 1975.

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BEITZ, DONALD C., Professor of Animal Science; Professor of Biochemistry. B.S., 1962, M.S., 1963, Illinois; Ph.D., 1967, Michigan State. 1967, 1977.

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BENEKE, RAYMOND R., Professor of Economics and Chair of the Department. B.S., 1940, M.S., 1946, Iowa State; Ph.D., 1949, Minnesota. 1948, 1959.

BENITEZ, ZULEYKA V., Assistant Professor of Art and Design. B.A., 1973, Virginia Polytechnic Institute; M.F.A., 1975, Louisiana State. 1976, 1980.

BENN, CHARLES L., Instructor in Agricultural Studies. 1945, 1970.

BENNER, WILLIAM, Assistant Professor of Freshman Engineering. B.S., 1947, B.S., 1949, Washington (St. Louis); M.S., 1957, Michigan; B.S., 1968, M.S., 1974, Iowa State. 1977. 1979.

BENNETT, ADRIAN A., Associate Professor of History. B.A., 1964, Antioch; M.A., 1966, Ph.D., 1970, California (Davis). 1970, 1974.

BENO, JOHN A., Associate Professor of Industrial Education. B.S., 1962, M.S., 1963, Eastern Illinois; Ph.D., 1975, Maryland. 1977.

BENSEND, DWIGHT W., Emeritus Professor of Forestry. B.S., 1937, Ph.D., 1942, Minnesota. 1947.

BENSON, DONALD R., Professor of English. A.B., 1949, Missouri (Kansas City); M.A., 1951, Colgate; Ph.D., 1959, Kansas. 1958, 1967.

BENSON, GARREN O., Professor of Agronomy. B.S., 1961, M.S., 1963, Minnesota; Ph.D., 1971, Iowa State. 1970, 1977.

BENSON, SUSAN M., Instructor in Food and Nutrition. B.S., 1974, Iowa State; M.S., 1978, Nebraska (Omaha). 1978.

BERAN, GEORGE W., Professor of Veterinary Microbiology and Preventive Medicine. D.V.M., 1954, Iowa State; Ph.D., 1959, Kansas; L.H.D., 1973, Silliman (Philippines). 1973.

BERAN, JANICE A., Adjunct Assistant Professor of Physical Education. A.B., 1953, Central; M.S., 1970, Drake; Ph.D., 1977, Iowa State. 1976, 1978.

BERARD, MICHAEL F., Professor of Materials Science and Engineering. B.S., 1960, M.S., 1962, Ph.D., 1968, Iowa State. 1964, 1977.

BERESFORD, HOBART, Emeritus Professor of Agricultural Engineering. B.S., 1924, A.E., 1941, Iowa State. 1948.

BERESFORD, REX, Emeritus Professor of Animal Science. B.S.A., 1911, Iowa State. 1928.

BERGAN, WILLIAM H., Adjunct Assistant Professor of Physical Education; Head Men's Track Coach. B.A., 1965, M.A., 1969, M.A., 1972, Northern Iowa. 1971, 1976.

BERGER, P. JEFFREY, Associate Professor of Animal Science. B.S., 1965, Delaware Valley; M.S., 1967, Ph.D., 1970, Ohio State. 1972, 1978.

BERGER, ROGER W., Professor of Industrial Engineering. B.S., 1958, Nebraska; M.S.I.E., 1962, Kansas State; Ph.D., 1968, Oklahoma State. 1972, 1980.

BERGLES, ARTHUR E., Professor of Mechanical Engineering and Chair of the Department. S.B., 1958, S.M., 1958, Ph.D., 1962, Massachusetts Institute of Technology. 1972.

BERN, CARL J., Associate Professor of Agricultural Engineering. B.S., 1963, M.S., 1964, Nebraska; Ph.D., 1973, Iowa State. 1968, 1976.

BERNARD, ROBERT W., Professor of Foreign Languages and Literatures. B.A., 1958, St. Thomas, M.A., 1962, Ph.D., 1968, Kansas. 1965, 1976.

BEST, LOUIS, Associate Professor of Animal Ecology. B.S., 1968, Weber State; M.S., 1970, Montana State; Ph.D., 1974, Illinois. 1974, 1979.

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MAHASKA COUNTY, OSKALOOSA — John W Patterson, Director, *Mary A Patterson Home Economist, *Tabitha G Aanonson, Home Economist

MARION COUNTY, KNOXVILE — George F Peisen Director; *Ardyce A Roehr Home Economist

MONROE COUNTY, ALBIA — Gary M Peterson, Director

VAN BUREN COUNTY, KEOSAUQUA — Dale R Miller, Director, Sandra J McLain Home Economist

WAPELLO COUNTY, OTTUMWA — Dale M Uehling Director, Barbara J Anderson, Home Economist

WAYNE COUNTY, CORYDON — Bradford Huffines Director, *Donna K Donald Home Economist

Sioux City Area

Roger D. Iverson, Area Extension Director

Myra D. Alley, Extension Consumer and Management Specialist; Timothy O. Borich, Extension Resource Development Specialist; Diane Flynn, Extension Human Development Specialist; Jack D Frus, Extension Soil, Water and Waste Management Specialist; Earl D Mobley, Extension Livestock Production Specialist; Kyle R. Peterson, Jr , Extension Crop Production Specialist; Gary L. Vogt, Extension Management Specialist.

CHEROKEE COUNTY, CHEROKEE — Forrest J Kohrt, Director, *Bertha J Shaw, Home Economist

CRAWFORD COUNTY, DENISON — Maclyn E LaRue, Director, Norma L Morgan, Home Economist, *Lee S Johnsen, 4-H and Youth Leader

IDA COUNTY, IDA GROVE — , Director, *Mary B Kennedy, 4-H and Youth Leader

MONONA COUNTY, ONAWA — Larry D DuVal, Director; Cheryl C Hardison, Home Economist

PLYMOUTH COUNTY, LEMARS — Allen E Plath, Director; Rhonda L. Fulcher, 4-H and Youth Leader

SAC COUNTY, SAC CITY — Floyd Schnirring, Director; *Betty Lou Deede, Home Economist

WOODBURY COUNTY, SIOUX CITY — Peggy M Haafke, Director; Richard O Pope, Extension Agriculturalist; Linda L Swenson, Home Economist Richard D Eberle, 4-H and Youth Leader

Spencer Area

W John Johnson, Jr., Area Extension Director

Dean L. Barnes, Extension Crop Production Specialist; Dennis L. DeWitt, Extension Livestock Production Specialist; Elizabeth A. Green, Extension Associate, Pest Management; Louie O. Hansen, Extension Resource Development Specialist; Leroy C. Kimmons, Extension Human Development Specialist; Anthony J Koenig, Extension Soil, Water and Waste Management Specialist; Edward M Rawson, Extension Farm Management Specialist, Denzil W Stacy, Industrial Specialist, CIRAS

BUENA VISTA, STORM LAKE — James D Nuss, Director *Rhonda K Christensen Home Economist

CLAY COUNTY, SPENCER — David L Hessman Director *Michael D Biedenfeld, 4-H and Youth Leader

DICKINSON COUNTY, SPIRIT LAKE — James A Yungclas, Jr Director, *Laurie Rosendahl, 4-H and Youth Leader

EMMET COUNTY, ESTHERVILLE — Gene Rullestad, Director, *Holle R Smith Home Economist

KOSSUTH COUNTY, ALGONA — John J Ley Director *Tracy V Remy 4-H and Youth Leader Cindy L Feil Extension Associate Agriculture

LYON COUNTY, ROCK RAPIDS — Roger A Baldwin Director, *Denise M Wyland, Home Economist, *Evelyn J Baldwin, Home Economist

O'BRIEN COUNTY, PRIMGHAR — Roger D Hansen, Director, *Rhonda D Rosenboom, Home Economist

OSCEOLA COUNTY, SIBLEY — Brian K Kemp Director, *Robert S McCoy 4-H and Youth Leader

PALO ALTO COUNTY, EMMETSBURG — Harold H Heykes, Director *Mary L Stoecker, Home Economist

SIOUX COUNTY, ORANGE CITY — Director *Nan E Grady 4-H and Youth Leader

Waterloo Area

Alvin T Goettsch, Area Extension Director

Verlyn K Anders, Industrial Specialist, CIRAS, Kay A Connelly, Extension Crop Production Specialist, Clair E Hein, Extension Resource Development Specialist, Philip P Hufford, Extension Farm Management Specialist, James J Meno, Extension Livestock Production Specialist, Norma S Peters, Extension Consumer and Management Specialist

BLACK HAWK COUNTY, WATERLOO — Larry E Loenser Director G Brooks Rector Home Economist Paul K Keefe Home Economist Carolyn L Stephenson 4-H and Youth Leader

BREMER COUNTY, TRIPOLI — J Russell Solheim Director, *Beth E Doran, 4-H and Youth Leader

BUCHANAN COUNTY, INDEPENDENCE — William R Lotz, Director Carol L Hans Home Economist, Denise A Stuedemann 4-H and Youth Leader

BUTLER COUNTY, ALLISON — Dale R Thoreson Director *Mary Lou TeWinkel 4-H and Youth Leader

CHICKASAW COUNTY, NEW HAMPTON — Gerald K Anderson Director, *Donna M Andrusyk, Home Economist

GRUNDY COUNTY, GRUNDY CENTER — Everett D Halstead, Director, *Fidella Knapp, Home Economist

TAMA COUNTY, TOLEDO — Richard D Pulse, Director, Lorne R Matters, Home Economist, Kathleen A McCarville, 4-H and Youth Leader

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* Has multi-county responsibility

Center for Industrial Research and Service

Headquarters Staff

David H. Swanson, Director

Lloyd E. Anderson, Industrial Specialist

William A. Berkland, Communication Specialist, CIRAS and Engineering Extension

James R. King, Industrial Specialist

Wilson A. Kluckman, Industrial Specialist

Edward O. Sealine, Industrial Specialist

Robert W. Shearer, Industrial Specialist

Carmi Spicer, Industrial Specialist

Blaine F. Vandeventer, Industrial Specialist

John H Wessman, Industrial Specialist

Field Staff

Cedar Rapids and Dubuque Areas — Martin T Poe, Jr

Creston and Council Bluffs Areas — Dwayne D Dygert

Davenport and Ottumwa Areas — Robert A. Lyon

Des Moines Area — James M. Schaaf

Mason City and Waterloo Areas — Verlyn K. Anders

Sioux City, Spencer and Fort Dodge Areas — Denzil W Stacy

Engineering Extension

R. E Patterson, Jr., Professor and Director

William R. Berkland, Communication Specialist, CIRAS and Engineering Extension

Gregg D. Cameron, Conference Coordinator

Simeon Gordon Dowell, Building Maintenance Specialist

Robert V Hansen, Fire Instructor

Steven E. Jones, Extension Specialist, Civil Engineering

Andrew I. Levy, Fire Instructor

Gerald M Mills, Fire Instructor

Jay T. Murray, Fire Instructor

Gregory C Noll, Fire Instructor

George Oster, Fire Instructor

Robert A. Patterson, Fire Instructor

Keith Royer, Coordinator, Fire Training

Terry Schwartzenbach, Fire Instructor

Roger K. Sweet, Fire Instructor

James F. Westphal, Fire Instructor

Professors: Burnet, Cowles, Ekberg, Kopplin, McRoberts, Patterson, Ring, Smith, Tamashunas, Townsend

Associate Professors: Baker, Barta, Bond, Coady, Gould, Hendricks, Lamp, Love, McMechan, Mohr, Musil, Watkins

Assistant Professors: Rossmiller, Sjobakken, Thiele

Instructor: Crow

Summary of Enrollment

1978-1979 A summary of different individuals enrolled during the year

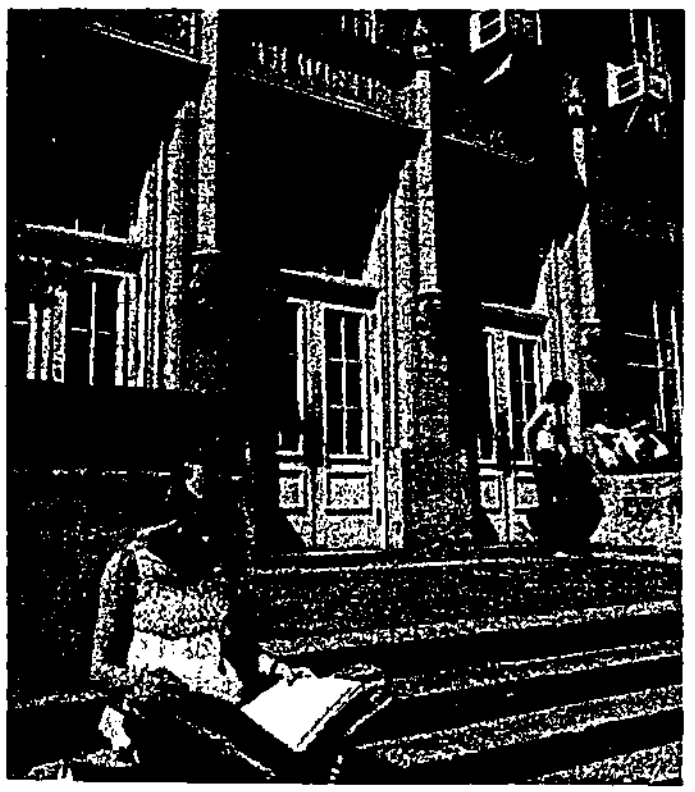
	Academic Year Sept 1978 - June 1979			Fiscal Year June 1978 - June 1979		
	Men	Women	Total	Men	Women	Total
Grand Total of all students	16,168	10,574	26 742	17,011	11,443	28,454
Total of all students of college grade	16,132	10,480	26,612	16,958	11,319	28,277
I. Students in residence of college grade	15,436	9,487	24,923	16,224	10,225	26,449
*College of Agriculture	3,181	730	3,911	3,245	751	3,996
*College of Design	853	781	1 634	853	781	1,634
*College of Education	490	853	1,343	523	929	1,452
*College of Engineering	3,812	341	4,153	3,922	351	4,273
*College of Home Economics	85	1,908	1,993	96	2,037	2,133
*College of Sciences and Humanities	4 282	3,640	7 922	4,492	3,828	8,320
*College of Veterinary Medicine	325	117	442	325	117	442
**Graduate College	2 567	1,121	3 688	2,928	1,435	4,363
Total	15 595	9,491	25 086	16 384	10,229	26,613
Duplicates	159	4	163	160	4	164
II. Students not in residence of college grade: extension, off-campus and UMA	696	993	1 689	734	1,094	1,828
III. Students in residence not of college grade: music, nursery school and safety education	36	94	130	53	124	177

1979-1980 A summary of different individuals enrolled during the year

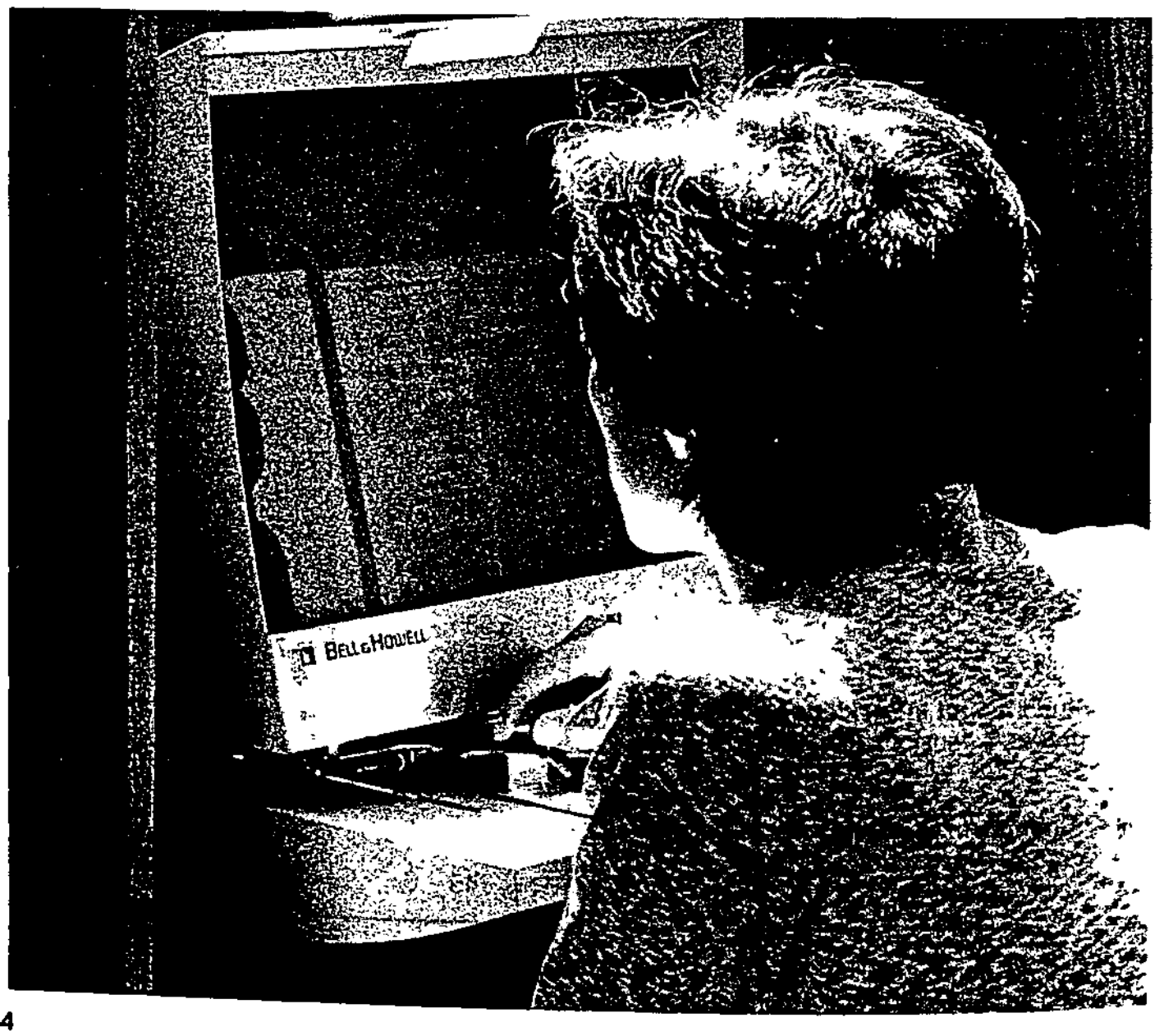
	Academic Year Sept 1979 - June 1980			Fiscal Year June 1979 - June 1980		
	Men	Women	Total	Men	Women	Total
Grand Total of all students	16,308	10,724	27,032	17,149	11,492	28,641
Total of all students of college grade	16,263	10,660	26,923	17,085	11,394	28,479
I. Students in residence of college grade	15,430	9,838	25,268	16,231	10,541	26,772
*College of Agriculture	3,051	752	3,803	3,130	772	3,902
*College of Design	1,020	1,012	2,032	1,052	1,047	2,099
*College of Education	476	865	1,341	518	921	1,439
*College of Engineering	3,884	415	4,299	3,981	425	4,406
*College of Home Economics	52	1,563	1,615	55	1,630	1,685
*College of Sciences and Humanities	4,399	3,873	8,272	4,603	4,076	8,679
*College of Veterinary Medicine	334	147	481	334	147	481
**Graduate College	2,369	1,218	3,587	2,718	1,530	4,248
Total	15,585	9,845	25,430	16,391	10,548	26,939
Duplicates	155	7	162	160	7	167
II. Students not in residence of college grade: extension, off-campus and UMA	833	822	1,655	854	853	1,707
III. Students in residence not of college grade: music, nursery school and safety education	45	64	109	64	98	162

*Data based on curriculum at time of first enrollment for the year
**Data based on status at time of first enrollment for the year

Degrees Awarded



	1978-1979	1979-1980	1872-1980
Baccalaureate Degrees (Total)	3,484	3,617	92 170
Doctor of Veterinary Medicine (Total)	88	122	3 672
Higher Degrees (Total)	866	818	23,071
Doctor of Philosophy	227	239	6,969
Master of Architecture	9	12	84
Master of Arts	33	33	310
Master of Community and Regional Planning	4	4	8
Master of Domestic Economy (Discontinued)	—	—	2
Master of Education	0	0	141
Master of Engineering	16	14	337
Master of Forestry (Discontinued)	—	—	5
Master of Landscape Architecture	5	4	70
Master of Philosophy (Discontinued)	—	—	7
Master of Public Administration	—	2	2
Master of Science	570	502	14,602
Specialist	2	8	10
Professional Degrees (Discontinued)			
In Engineering	—	—	354
Master of Agriculture	—	—	58
Master of Forestry	—	—	12
Master of Landscape Architecture	—	—	1
Honary Degrees			
Doctor of Agriculture	—	—	10
Doctor of Engineering	—	—	14
Doctor of Laws	—	—	9
Doctor of Science	—	—	51
Master of Philosophy	—	—	6
Master of Science	—	—	9
All Degrees Conferred	4,438	4,557	118,913



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